Counterfeited Product Identification in a Supply Chain using Blockchain Technology

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Abstract

Since the invention of the Blockchain technology in 2008, it has been used in many domains to ensure high security and reliability of data, like from the use of Bitcoin to BaaS (Blockchain as a Service) which is a new blockchain trend and is a sort of cloud-based network for the organizations in the business of building blockchain-based applications. This paper implements the combined approach of the decentralized Blockchain technology and the Supply Chain to establish that the end-users in a supply chain do not completely rely on the trader to establish that the product is counterfeited or not and this can be done by authenticating the product at every stage in the Supply Chain by using One Time Passwords on the receiver's mobile phone along with a deployed personnel who will be responsible for assuring the quality of products. Furthermore, using this combined technical approach can considerably lower down the cost of product quality assurance and this proposed system will track the authenticity of the product from its origin from the manufacturer to the end-user as well.

Keywords: Blockchain, Supply Chain, Counterfeited Product Identification, Security.

1 Introduction

Blockchain technology in Supply Chain is legitimately a viable combination that is highly dependable and secure in terms of getting non- counterfeited goods from the market. It is being used along with the trending technologies like the Internet of Things(IoT), Near-Field Communication(NFC), and Artificial Intelligence to increase its productivity and usage in many industries like the pharmaceutical industry, the financial industry, liquor industry with the same intention of detecting and protecting the counterfeited goods. Some of the researchers have also used the Radio-Frequency Identification (RFID) technology, the barcode scanning technology, and even Machine Learning as an add-on characteristic in the Blockchain in Supply Chain technology which has proved to have stopped the counterfeited products in the community to a great extent, but still, they had certain limitations like the solutions proposed by the researchers are complex and not much user-friendly and also there are no dynamic authentication methods used on the products in the supply chain which could have helped the supply chain in becoming healthier and user-friendly. This could have been improved by just adding a unique method of authentication which we generally use in multiple areas to verify our authenticity and that is, by using the *One Time Password* that is valid only for a single time and can be easily used by the members in the supply

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chain creating a hassle-free environment for all and also to detect the counterfeited products, i.e. if the receiver would not get the OTP from the sender of the goods then the receiver would not get access to the products.

2 Related Works

2.1 Anti-Drug Counterfeiting

Zhu et al. [25] proposed a system in their paper that prevents counterfeiting of drugs and increases the traceability in the pharmaceutical industry using Blockchain Technology. According to the authors, the blockchain also makes it more convenient to perform trace-ability and fake product identification along with making a smooth and clear flow of drugs along the supply chain. This study uses the Python scripting language to imitate the block-chain operations and the testings are done on a single computer rather than an assembled deployment. It is also told that it will be checked in the future that whether there can be a superior manner to make the blockchain environment in an assembled deployment to enlarge the usefulness of the testing or not. By the approach given in this paper, it shows that it lowers down the energy expenditure which in turn makes blockchain technology more fitting drug anti-counterfeiting and traceability. Also, the aim is to keep exploring the blockchain applications in the future to perform even more systematic analyses which can be of a greater potential which can help in attaining even more useful outcomes, and Kuo et al. [10] introduced the renowned cryptocurrency Bitcoin and the basic Blockchain technology that offers decentralized management, an abiding pathway of audit, the inception of data, availability and hardiness and data confidentiality.

The distributed ledger technology of blockchain has made an elevation in the health care industry in various ways and also several new applications are also expected to appear soon in the coming future, and Sylim et al. [21] by using the Blockchain Technology tested the feasibility in a pharmaceutical surveillance system and as we understand the importance of having a check on the counterfeited medicines as it can have the possibility to cause a great loss to the society who consume the fake medicines and also this could lead to death in the worst-case scenario. To protect this from happening and to get rid of the counterfeited medicines the authors prepared the harmacosurveillance Blockchain system which contained a Distributed Application with a back-end Distributed File System supporting a private blockchain network that will make use of smart contracts. Also, this system's prototype is designed with five starting nodes, one for each participant in the conventional drug distribution model containing the manufacturer, the distributor, the marketer along with an extra node which will house a website through which the end-users will be able to scan codes which will come along with the receipt of their purchases to observe the history of drugs distribution.

The use of RFID tags in this system will be an add-on reliable feature to keep track of the drugs and protect against anti-counterfeiting. In the system, each node will contain an RFID scanner and RFIDs will be integrated into the drug product bundles at the manufacturer level and will be added as a data point down the supply chain, where the data mismatches will be notified and counterfeited products will be traced.

Sahoo et al. [15] proposed the ECDSA(Elliptic Curve Digital Signature Algorithm) in their paper which added traceability and visibility for the protection of drug counterfeiting in the pharmaceutical industry and provided a strong and transparent drug supply system by which we can block the loopholes in our current drug supply chain. This paper becomes important for the pharmaceutical industry since there is an urgent requirement for improvement in the medical industry as there is a lot of distrust regarding the genuineness of medicines in the consumer's mind which will be fulfilled by this methodology. But, if we take the flip side of the security and transparency provided there are still the chances of a malicious entity replacing the genuine medicines with the counterfeited medicines so blind faith

in any methodology may lead to life-threatening problems in a worst-case scenario, whereas Saxena et al. [17] present a blockchain-driven tool in their paper that can record, time-stamp the transfer of the drugs in a supply chain. Their research examines the effect of the consumption of fake medicines which often lead to health degradation of the community and to curb the same issue of drug counterfeiting, the authors proposed a mobile application based tool with features like bar-code scanning(it will enable the mobile device to upload the information to the blockchain just by scanning the bar-code), creation of asset(As soon as the drugs enter the supply chain this application is able to create new assets whose information will be updated in the blockchain and will be assigned a unique identification number), asset transfer(when a medicine is forwarded on to the next portion in the supply chain then it gets recorded in the application tool), looking at the scanned medicines(the user is able to look for all the user-scanned products). The proposed Pharmacrypt tool allows both the hospitals and the end-users to check the origin of the medicine at any point of time in the supply chain as the tool is simple to use with a user-friendly interface so the staff need not get any sort of training to the prevailing medicine scanning experiences in hospitals. Although the proposed tool is undoubtedly effective in checking the medicine counterfeiting, large scale deployments would still need much better testing to be used as a basis for future research and development in similar domains, and Clauson et al. [5] through their study provide an overview of the blockchain technology and its opportunities in today's world in the health supply chain keeping a watch on the medicine supply, the medical machinery supply and the Internet of Healthy Things(IoHT) non-counterfeited. The quantity to use the smart contracts to automate the processes as there are always high chances of human error in the manual method and it is also not much reliable and it reduces the overall cost which is an important mechanism by which the blockchain technology could help in increasing the supply chain performance whereas Sahoo et al. [16] explains the details of drug counterfeiting and the impact which is made on society along with various methodologies used to curb the rising drug counterfeiting in the industry. In the proposed model of their paper, they divided the whole drug supply chain starting from the manufacturer to the patient into six parties which are the Manufacturer, Distributor, the Transporter, the Pharmacy, Hospital and the patient, where each party must contain dependable and trustworthy employees and also this model will also contain a shared ledger system that will prevent drug counterfeiting from happening along with making the drug supply chain more trustworthy and robust which will also clear the remaining vulnerabilities in the drug supply chain. Also, this model not only keeps a check on drug counterfeiting but can also be used in tracking and tracing the products to schedule the delivery date of the product.

2.2 Supply Chain with additional technologies

Blossey et al. [3] proposed the combination of the Blockchain and the Supply Chain management technology to summarize a present state of technology and to discover further possibilities in various areas in the future, and for this same intention, the authors prepared a broad structure containing the use case clusters of the blockchain technology in supply chain management which is prepared according to the typical features of the blockchain technology and used a comprehensive framework of use case clusters to analyze 53 applications of Blockchain Technology in the Supply Chain Management. This study can be compiled into a few categories which include the use of the applications of the blockchain technology in the supply chain management that can be divided into five use case clusters, also Tribis et al. [22] aims to analyze and inspect the current state of the Blockchain applications on the Supply Chain Management, and this study demonstrates a systematic mapping to find out all the relevant findings on Supply Chain Management based on the Blockchain technology. Although the proposed solutions are effective many of them lack in performance in context to the large industries, and Alzahrani and Bulusu [2] used two trending technologies, namely Blockchain and NFC Technology, and proposed a new decentralized supply chain that detects the counterfeiting threats and attacks using the blockchain and Near Field

Communication(NFC) technologies and also traces the counterfeited products using the blockchain technology. Their simulations of the combined technical approach are evident of the great performance and security provided as compared to the generic ineffective supply chain management system in tracking the counterfeited products. A unique thing about their work is that this system can detect modification, cloning, and tag reapplication attacks by necessitating the nodes of the supply chain transparently.

Also for this blockchain, the authors introduced a new scalable, dependable and robust consensus protocol and even the simulations which they have made to test their invention also proved to be effective and efficient for bigger networks which makes it an acceptable as well as a satisfactory choice for large blockchains that need full centralization. According to their work the validators' set changes dynamically each time when a new block is created but the number of the validators is static which can be a vulnerability and can be exploited by an antagonist. So, a future solution for the same vulnerability can be to make the number of validators dynamic depending upon the blockchain malevolence factor, where Paliwal et al. [12] made a theoretical contribution in their paper by providing a classification level based on the widely used Technology Readiness Level and the Grounded Theory. The research made by the authors showcases the unruly power and the role of blockchain-based systems in the domain of supply chain management. This paper presents a reusable classification framework - emerging technology literature classification level (ETLCL) based upon the grounded theory and the readiness level of the technology for performing literature reviews in several primary areas of growing technology. The ETLCL structure can be put in for contemplating the other growing technologies in any theme. This structure may be applied only to produce the best categories or to an already prepared double deep-level categorization scheme. This paper also shows how TRL can be mixed with the classical Grounded Theory to arrive at a deep double-level classification scheme. Also, this study emphasizes presenting a summary of the literature reviewed and organized by the novel classification structure and searching and making subcategories.

Gonczol et al. [6] demonstrate the present status of research on Supply Chains and summarize the advantages of it and the problems faced by the distributed organizations and the Supply Chain management systems. The primary goal of the authors is to combine Blockchain technology with the Supply Chain in order for the betterment of the future technology of the Supply Chain and its applications. The authors believe that the combination of these two technologies has several advantages including the rapid identification of fake products and fraudulent cases along with the level of clarity and reliability in the Supply Chain. It also includes the idea of using IoT devices along with this combined technology framework to increase the level of security and dependability. In this paper, the authors summarized the advantages and disadvantages of the adoption, to provide a strong base for future researchers to deviate their future researches towards making the technology and its applicability, even more, better in the correct direction.

2.3 Anti-liquor Counterfeiting

Sun et al. [20] developed an Ethereum and Radio-frequency identification (RFID) based system model in combination with the Blockchain and Internet of Things (IoT) technologies to prepare a fake liquor detection system. In this system, the RFID readers are used to automatically upload data in the liquor supply chain and stores the data in form of hash values in the blockchain to ensure that the data remains confidential and cannot be traced, modified, and tampered with. Using this system in the liquor industry will be good for both the industries and the consumers and also the community will gradually gain the trust of the industry and will be mutually beneficial for all.

Along with these benefits, the application of RFID technology can also be used at the time of buying on the checkout counter as the embedded RFID readers in the checkout counter can automatically sum up the price of the products even without going through the process of manual scanning. Along with this, at the same time, the sale data will get stored in the blockchain which will be a way more convenient option

for the shopkeepers to monitor the products easily and protect the RFID tags from being reused after being bought by fraudulent consumers. All the people involved in the supply chain can easily monitor the genuineness of liquor,track-and-trace the products which makes it non-tamperable and transparent.

2.4 Product anti-counterfeiting using Blockchain

Ma et al. [11] proposed a fully anti-product forgery system to implement a Blockchain architecture provided by Ethereum to record product ownership on the Blockchain. By using this technology's transparency properties, and the guarantee that each record cannot be faked on the Blockchain, the end-users do not require to completely depend upon trusted third parties to carefully know the origin of the bought product.

Small and medium-sized organizations can make use of this anti-product forgery application that will bring down the fees which they need to pay to monitor the authenticity of the products and by this system the authors of this paper aim to solve the issue of brand anti-counterfeiting certification and providing the small salespersons an opportunity to validate the source of each component of their product [8, 18]. Using the completely revealed smart contract details, anyone can simply verify the genuine source of the business and can even serve as proof for the end users' purchase of goods. For retailers, it is possible to prove whether they provide legitimate products by using this anti-counterfeit Blockchain system. So by using this approach the users of this system will be benefited in a manner as firstly, they will have to pay a low transaction fee, and secondly, they need not be concerned about acquiring a fake product.

S. Uhlmann [23] explores the chances to lower down the fake products using the Blockchain technology and his thesis also shows that the counterfeiting of products cannot be brought down only by the use of technology but people do require to maximize their general awareness and they should start challenging the caught counterfeited products legally in court, and must be having an inviolable packaging of the products as well in order to assure of its safety. In this thesis, the issues and results of counterfeiting were acknowledged and different blockchain technologies and deployment models are discussed and analyzed to achieve the goal of reduction in the counterfeited products in the market. The authors believe that alone blockchain cannot bring down the fake products in the market but it can be useful when combined with some other trending technologies of today's world like using Internet of Things(IoT) devices where each transaction of a product is saved, and this can allow proper transparency along with data security.

The combination of the IoT and Blockchain technology might empower utilization on the ways to reduce counterfeits. we have observed in this paper that no such model is proposed which could effectively lower down the counterfeits, instead only ideas were provided as future work for the combination of Blockchain with IoT to prevent product counterfeiting.

2.5 Applications of Blockchain in Supply Chain

Chang and Chen. [4] contribute to the understanding of the blockchain applications in supply chain management and comes up with a plan for these applications from the viewpoint of the literature analysis. The reason for using the Systematic Literature Review(SLR) is to demonstrate a general summary of the recent research by performing a systematic analysis of the extent of literature. This study is an add-on to the understanding of blockchain applications in the supply chain domain by finding different research topics and paths for future researches in a similar domain. The primary objective of this paper is to give a structured review of extant studies to get a clearer understanding of the applications of such technologies. The future works in blockchain technology can include certain technical problems like scalability, the inter-working of the blockchain, and also the security issues in blockchain, and Song et al. [19] worked upon the improvement of the operations and the supply chain functions and this paper primarily focuses on the effect that blockchain will make upon the supply chain to make advancements in the transparency,

the detectability, and accessibility of the flow of products alongside the supply chain containing the manufacturers and end-users. This study has researched the present applications used in the industries to monitor and trace the supply chain operations in industries and it also talked about its future work for further industrial applications. The LoRaWAN based solution can be also applied in supply chain and smart factory [9, 14, 24].

A good number of Information and Communication Technology(ICT) based Supply Chain traceability solutions are been implemented for the welfare of the industry as well as for the society, and also the supply chain detectability means an overall better environmental feasibility. This paper did not provide a fair amount of ideas or any adequate number of suggestions or any proposed solution model for their current work and did not contribute much even for future works but it was primarily based upon the improvement of the supply chain features using the blockchain applications.

2.6 Blockchain based researches

Gopichand et al. [7] described in their paper that blockchain-based applications are trending in today's world taking from the Internet of Things(IoT) to various other money-related organizations due to its secure and dependable nature which is also used in this paper that introduces a far reaching perspective on the blockchain revolution. It is also told in this paper about the various future works and work patterns on the blockchain technology along with a blockchain architecture which consists of continuous blocks of information containing the block version (shows that which set of the block validation policies are to be taken into consideration), the Merkle tree root hash(which demonstrates the hash cost of all transactions inside the given block), time-stamp(which tells the modern day time),n Bits(which is the targeted threshold of a genuine block), the parent hash block (which is a 256-bit hash block which points to the previous block) et Cetra. The authors also made a discussion about the consensus algorithms used in the blockchain and also compared such protocols with different approaches, moreover, they believed that blockchain is a growing technology and so they plan to do deep investigations on the blockchain-based applications in the coming future. Adsul and Kosbatwar [1] explain in their paper the use and importance of using the growing blockchain technology in the pharmaceutical industry in order to lower down the counterfeited drug production and sale since their pharmaceutical delivery chain possesses features like transparency, traceability, and security. This proposed model may be used in the pharmaceutical industry to keep a track on the medicines from their manufacturing stage until it gets delivered to the consumer and after the delivered medicine has been consumed by the patient then its consequence on the patient will be recorded to a database for future references and statistics.

The primary objective of the existing studies is to prevent drug counterfeiting and protect public health and fitness, and the secondary objective is to discover the awareness of the counterfeited medicines issue that really needs an urgent level of security for proper handling of the medicines in the pharmaceutical industry. Also, the authors believe that the manual and automated UI based testing has become ineffective in today's world where Machine Learning based methodologies are prevailing so manual testing should be replaced with Machine learning-based testing to reduce time and increase the overall productivity and accuracy whereas,Rao and Shankara [13] suggested the security implications in the financial sector using blockchain technology. They believed that there is an urgent requirement for developing a robust and dependable system for online transactions which requires sustaining a good level of security towards the finance and other aspects of the community. The Socket Security Layer(SSL) security estimates the client data and also encrypts the same, then the encrypted data will be forwarded to the server where it performs decryption of the data and accesses the information and this process helps in providing security for the data transportation. Also, the authors believed that the financial sector requires a sort of system model which prevents the tampering of the transactions and also aids in maintaining the system which can be obtained through Blockchain technology.

Table 1: The state-of-the-art comparison of existing studies in Contribution of blockchain-based Supply Chain Management {P1-Security, P2-Contribution in Supply Chain Management, P3-Effective, P4-Biometric result, P5-Direction for future work}.

Authors	**Main Contribution**	**P1**	**P2**	**P3**	**P4**	**P5**
Blossey et al. [3]	Use of a comprehensive framework of use case clusters to analyse 53 applications of Bitcoin Technology in Supply Chain Management	Yes	Yes	Yes	Yes	No
Song et al. [19]	Improvement of operations and the supply chain functions	Yes	Yes	Yes	No	Yes
Sun et al. [20]	Using Blockchain and RFID technology to prepare fake liquor detection system	Yes	No	Yes	Yes	Yes
Sahoo et al. [16]	Protection of drug counterfeiting in pharmaceutical industry using Blockchain Technology	Yes	Yes	Yes	No	Yes
Saxena et al. [17]	It presents a blockchain-driven tool which can record/time-stamp the transfer of medicines in a supply chain	Yes	Yes	No	Yes	Yes
Ma et al. [11]	It offers a fully-functional anti-product forgery system using Blockchain Technology	Yes	No	Yes	Yes	Yes
Sylim et al. [21]	Using Blockchain Technology it tests the feasibility in a pharmaceuticals surveillance system	Yes	No	Yes	Yes	No
Paliwal et al. [12]	It makes a theoretical contribution by providing a classification level based on the widely used Technology Readiness Level and Grounded Theory	Yes	Yes	No	Yes	Yes
Alzahrani and Bulusu [2]	Using Blockchain and NFC Technology it proposed a new decentralized supply chain to track and trace products	Yes	Yes	Yes	No	No
Zhu et al. [25]	It proposes a system which prevents counterfeiting and increase traceability in the pharmaceutical industry using Blockchain	Yes	No	Yes	Yes	Yes

3 Blockchain - Concept

Blockchain can be understood as a structure of data holding certain records which ensures data security, total transparency of the data, and decentralization. It is a P2P (peer-to-peer)network that provides much better security as compared to any traditional client-server system.

Blockchain uses two types of cryptographic algorithms, asymmetric-key algorithms, and hash functions. In asymmetric key algorithms, the Digital signature is an important part as they are easily attestable, cannot be manipulated, and also provide integrity to the whole procedure. The hash functions play an important role in linking the blocks of the blockchain with each other and in maintaining the integrity of data inside each of the blocks. In case if somebody wishes to change the input to the hash function, then they will notice a totally different output as compared to the genuine output. These features make it feasible for the blocks to get properly linked by other blocks and also assure the dependability and stability of the data stored in the blockchain.

3.1 Types of Blockchain

There are four different types of blockchains :

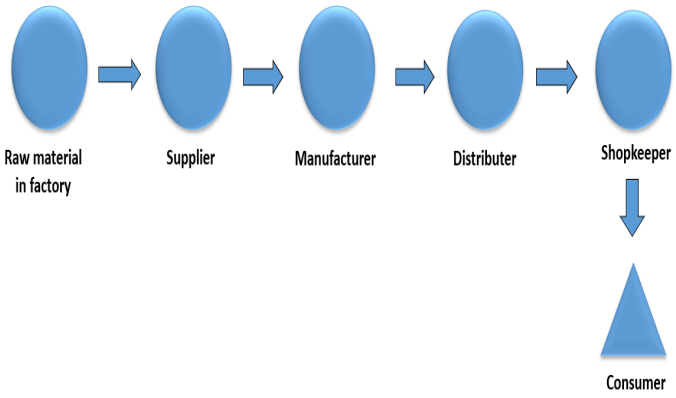


Figure 1: The flow of a Supply Chain.

Public Blockchain - It is used for exchanging the cryptocurrencies like Bitcoin, Dogecoin blockchains, and for mining purposes. Generally, the public blockchains are secure until the users strictly follow the security rules.

Private Blockchain - It is used within an organization where only a selected number of employees can become the participants of the blockchain network, so the robustness of security depends upon the organization only. It can have several layers of data access to maintain the privacy and confidentiality of data. The private blockchain networks are used in Supply Chain Management, Voting, etc.

Hybrid Blockchain - It uses the features of both the public and private blockchains, so users in a hybrid blockchain can control who gets access to which data is stored inside the blockchain. The Hybrid blockchain is used in the aviation industry and supply chain management etc.

Consortium Blockchain - It is used by the financial sector and a few government organizations as it is a semi-decentralized type of blockchain where more than one company manages a particular blockchain network. The features of a Consortium blockchain are the opposite of the Private blockchain but both of them are used in enterprise companies.

3.2 Supply Chain Management

The management of the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace.

A supply chain is the connected network of individuals, organizations, resources, activities, and technologies involved in the manufacture and sale of a product or service. A supply chain starts with the delivery of raw materials from a supplier to a manufacturer and ends with the delivery of the finished product or service to the end consumer.

Supply chain management is often described as having five key elements: planning, sourcing of raw materials, manufacturing, delivery, and returns as shown in figure 1. The planning phase refers to developing an overall strategy for the supply chain, while the other four elements specialize in the key requirements for executing that plan.

Supply Chain Management strives to link the various stages of the supply chain taking from the supply, manufacturing, and distribution of a product. By controlling the supply chain effectively and consistently, the organizations can bring down the extra costs and also the delivery of the items to the consumer becomes faster and this can be only achieved by maintaining strict standards, training and

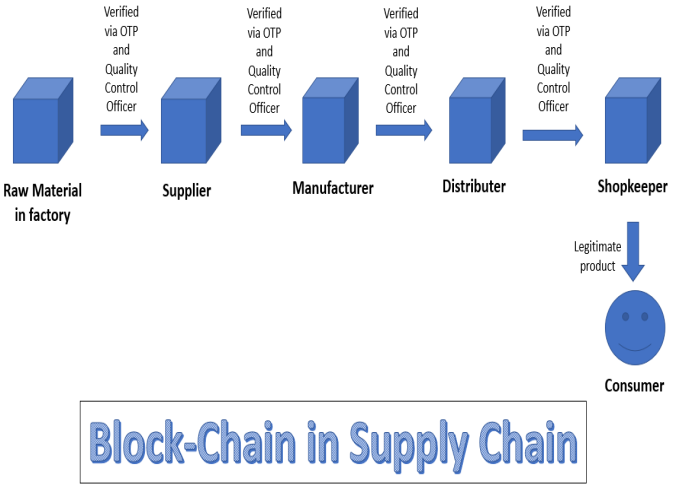


Figure 2: The proposed system model for block chain based supply management.

control of the internal staff, data, distribution, production, trading and maintaining the internal records.

It is responsible for keeping track of all the products inside the supply chain to prevent any counterfeiting of the products which would gradually build trust in the community and will be generally good for the reputation of the industry. The supply chain manager's job is not only about the logistics and purchasing the checklists but also to minimize any sort of product shortages, to satisfy the demands of the consumer, and also to keep the costs down as these type of advancements and good management have a genuine and long-lasting effect.

4 Proposed Solution

4.1 System model

The system model shows the flow of the products in the supply chain using blockchain technology as described in figure 2.

Firstly, the members involved in the supply chain(the factory in charge, the supplier, manufacturer, distributor, and the shopkeeper will be required to create an account on "`https://www.textlocal.uk`" in order to send and receive OTP messages to and from the other members of the supply chain to complete the proposed authentication process(it is a temporary method for OTP verification but in the future works, a proper mobile application will be prepared along with the purchase of the SMS API) as this website uses the SMS APIs and plugins to send the OTP messages for authentication purposes.

After successfully creating an account on text local. in, the users will be required to visit "`https://control.textlocal.co.uk/docs/`" and choose the option for "Send SMS via PHP," then copy down the generated code with a unique hash key, and paste the content in a preferred IDE. Now, save the file with a .php extension that can be run in the localhost and finally the OTP verification platform is created for all the supply chain members.

Also, the Blockchain in Supply Chain technology along with the OTP authentication system will not be enough to assure the products to be genuine without any discrepancies but it will also be required to contain trustworthy members in the supply chain along with a "Quality Control Officer" who can randomly check any of the goods at any point of time in the supply chain to ensure that every member in the supply chain is doing their job correctly without any sort of unfair means.

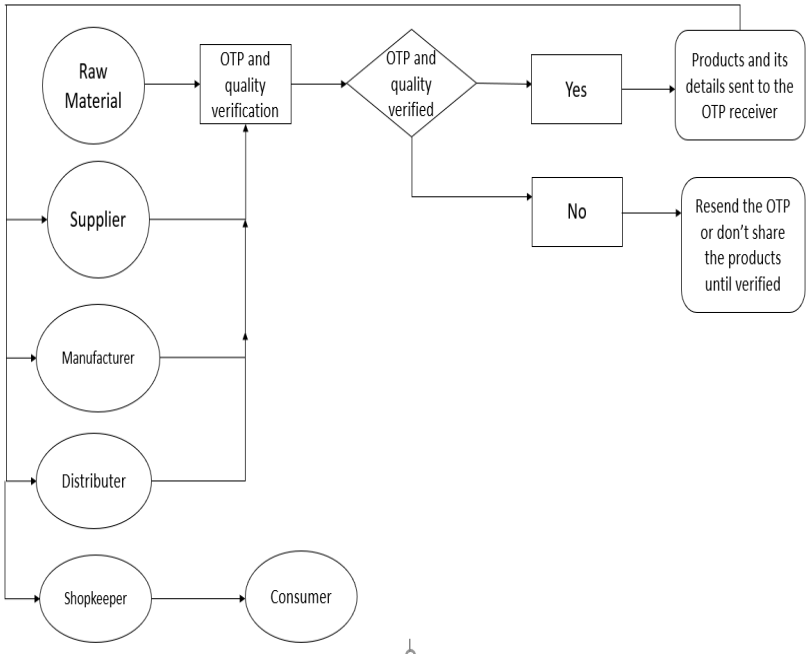


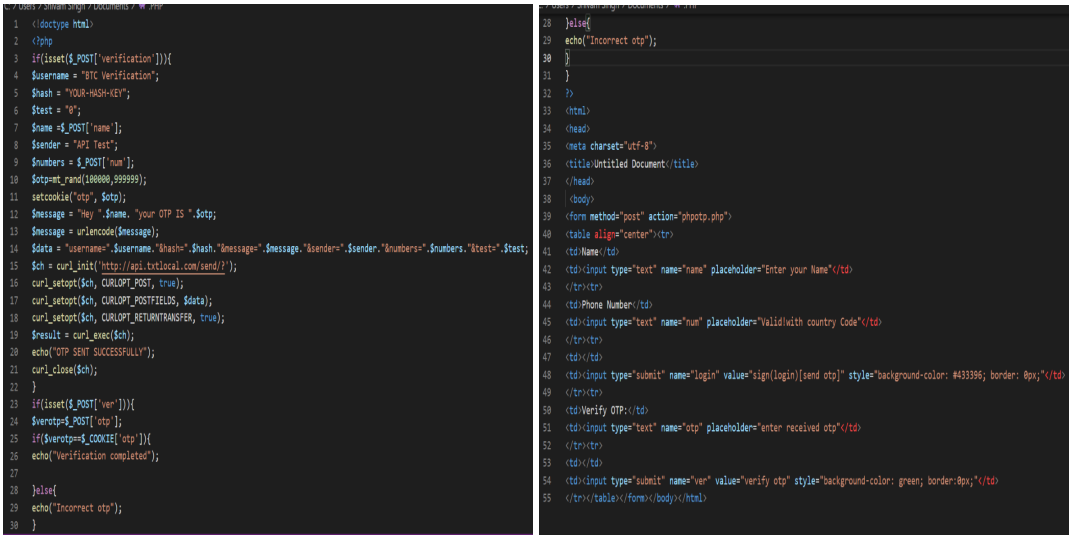
Figure 3: Flow diagram of proposed Supply Chain Scheme.

Now, in the initial stage of the supply chain, the raw materials from the factory will be transferred to the supplier only after the successful verification of the OTP message by the factory in charge on the phone check whether the supplier is genuine, once the OTP gets matched and "Quality Control Officer" has reviewed the products, then the factory in-charge will send the ordered number of goods along with their details to the supplier which will be saved in the blockchain and all the members of the supply chain (from the supplier to the shopkeeper) along with the "Quality Control Officer" can keep track of the goods in this transparent and reliable manner. Further, the verification process and transfer of goods will continue similarly for the remaining parts of the supply chain until the product finally reaches the consumer.

4.2 Implementations

Our proposed methodology can be implemented in various sectors including the food industry, agriculture industry, pharmaceutical industry, etc. In our approach, the members of the supply chain will have to follow the OTP verification on their mobile phone before receiving the products and once the products are received by them, then this will be updated in the blockchain to which every member of the supply chain will be aware along with the "Quality Control Officer" who can be deployed to the supply chain by the factory in-charge in order to ensure that any of the products are not compromised at any point in the supply chain and consequently the consumer will receive the genuine products which are overall good for the organization's reputation.The flow diagram of proposed Supply Chain Scheme is shown in figure 3.

The PHP source code, as shown in figure 4 is attached here that is prepared for the working of the OTP verification part in the different stages of the supply chain. It is a temporary method for the OTP verification by using a third-party website as currently it is done for demonstrative purposes but it can become a base for future enhancements on the given model by developing our web and mobile applications for the same.



```php
<!doctype html>
<?php
if(isset($_POST['verification'])){
$username = "BTC Verification";
$hash = "YOUR-HASH-KEY";
$test = "0";
$name =$_POST['name'];
$sender = "API Test";
$numbers = $_POST['num'];
$otp=mt_rand(100000,999999);
setcookie("otp", $otp);
$message = "Hey ".$name. "your OTP IS ".$otp;
$message = urlencode($message);
$data = "username=".$username."&hash=".$hash."&message=".$message."&sender=".$sender."&numbers=".$numbers."&test=".$test;
$ch = curl_init('http://api.txtlocal.com/send/?');
curl_setopt($ch, CURLOPT_POST, true);
curl_setopt($ch, CURLOPT_POSTFIELDS, $data);
curl_setopt($ch, CURLOPT_RETURNTRANSFER, true);
$result = curl_exec($ch);
echo("OTP SENT SUCCESSFULLY");
curl_close($ch);
}
if(isset($_POST['ver'])){
$verotp=$_POST['otp'];
if($verotp==$_COOKIE['otp']){
echo("Verification completed");

}else{
echo("Incorrect otp");
}
}else{
echo("Incorrect otp");
}
?>
<html>
<head>
<meta charset="utf-8">
<title>Untitled Document</title>
</head>
<body>
<form method="post" action="phpotp.php">
<table align="center"><tr>
<td>Name</td>
<td><input type="text" name="name" placeholder="Enter your Name"></td>
</tr><tr>
<td>Phone Number</td>
<td><input type="text" name="num" placeholder="Valid!with country Code"></td>
</tr><tr>
<td></td>
<td><input type="submit" name="login" value="sign(login)[send otp]" style="background-color: #433396; border: 0px;"></td>
</tr><tr>
<td>Verify OTP:</td>
<td><input type="text" name="otp" placeholder="enter received otp"></td>
</tr><tr>
<td></td>
<td><input type="submit" name="ver" value="verify otp" style="background-color: green; border:0px;"></td>
</tr></table></form></body></html>
```

Figure 4: Source code.

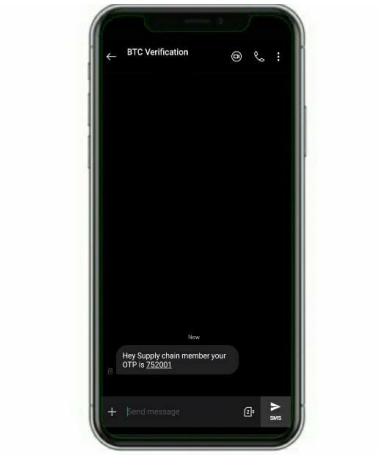


Figure 5: BTC Verification.

4.3 Results

The supply chain members will be receiving an OTP on their mobile number sent by the supply chain member of the previous stage under the supervision of the “Quality Control Officer” who will be the main person behind the accurate transfer of goods and the product verification by the supply chain members. The figure 5 shows how a member receives an OTP by the name of “BTC Verification” and when the OTP is verified on the sender’s end and the “Quality Control Officer” has also verified the products then all the asked products are rightfully forwarded to the receiver’s side.

The given table 2 shows the The state of the art comparison of the general supply chain and the proposed work..

Table 2: The state of the art comparison of the general supply chain and the proposed work.

S. No.	General Supply Chain	Proposed Blockchain based Supply Chain
1	Improper product handling with less focus on quality	Proper product handling with major focus on quality and authenticity
2	Tracking-and-tracing products is complex and challenging	Products can be easily tracked-and-traced in our blockchain environment
3	Less transparency and more cost expenditure in authenticating the products	More transparency and less cost expenditure in authenticating the products
4	No higher authorities involved in product and the supply chain members inspection	A "Quality Control Officer" is deployed to inspect the products and correct the supply chain members in case of discrepancies

5 Conclusion

This paper presents a modern and convenient phenomenon using the Blockchain and Supply Chain technologies which itself dispenses high security and transparency in the system, but to escalate these features some extra characteristics are added in this study which is using the One Time Password (OTP) authentication for verifying the legitimate supply chain members and products, and updating the product details in the blockchain after it is sent to the next stage in the supply chain, and further the product standards are monitored by the Quality Control Officer who is deployed by the factory in-charge for the same. Taking inspiration from the related works of the researchers who have developed various creative models which have been of great use to the community in preventing the counterfeit of products in different industries. This study can be summarised by considering our System model which picturizes the whole supply chain process from the factory stage to the consumer, the flow diagram that explains the processes in brief, and the web application which uses the SMS API and is utilized in the verification of the members of the supply chain by an OTP on the product receiver's mobile phone. In the future, it is believed that this methodology can be made a base and many more features will be added to it including a mobile application that can be installed in the mobile phones of the supply chain members for a smoother experience for OTP verification and tracing-and-tracking the product easily making the system even more transparent and stable.

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