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# Exploring the Role of Blockchain in Promoting Transparency in E-Invoicing Systems Among Multinational Corporations in Nigeria

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## Abstract

Blockchain technology has gained attention because of its potential to increase transparency through decentralized, immutable, and cryptographically secure transaction records. This paper explores blockchain's role in promoting transparency in e-invoicing systems used by multinational corporations (MNCs) operating in Nigeria. E-invoicing automation has gained popularity due to the benefits of reduced costs and improved efficiency. This paper analyses blockchain's applicability by examining its technical architecture, the current state of e- invoicing used by MNCs in Nigeria, key challenges faced, and relevant regulatory frameworks. Pioneering case studies demonstrate blockchain's commercial viability for coordinating complex cross-border business networks. This study suggests a new framework with parts for a public-private blockchain system that can work with each other. This could change the way e-invoicing is clear by rebuilding trust digitally between different parties.

***Keywords:*** *Blockchain, Data Security, E-invoicing, Multinational Corporations, Transparency.*

## INTRODUCTION

E-invoicing refer to the digital creation, sending, and handling of invoices between business partners (Tung et al., 2019). In recent years, it has become increasingly popular due to its advantages in cost reduction, enhanced efficiency, and the automation of corporate processes (Celik et al., 2020). Nevertheless, transparency remains a major concern for the numerous e- invoicing systems. Conventional electronic invoicing relies on centralized ledgers that are under the control of single entities, such as governments or private companies (Attaran & Gunasekaran, 2019). This provides the controller with a significant amount of supervision and awareness of transactions, but it restricts the level of transparency available to other individuals or groups involved (Yli-Huumo et al., 2016). Buyers and suppliers lack visibility into the workflows of invoice processing and are incapable of independently verifying records (Kannengießer et al., 2016). In addition, the absence of uniformity across international boundaries and among privately managed records creates isolated data repositories that hinder comprehensive visibility (PwC, 2018).

Resolving errors or conflicts becomes challenging when various entities use separate systems without a clear record of transactions (OECD, 2019). This erodes confidence among business partners, particularly in cross-border commerce (European Commission, 2019). Distributed ledger technologies offer a potential solution by enabling decentralized consensus without the need for intermediaries (Yli-Huumo et al., 2016). Blockchain, a well-known form of distributed ledger, has gained significant attention due to its capacity to enhance transparency through the use of shared, unchangeable, and cryptographically protected information (Crosby et al., 2016). Blockchain has the potential to resolve existing transparency issues in e-invoicing by providing all parties involved with a centralized and reliable source of information. Nevertheless, additional empirical research is necessary to determine the practicality of implementing it in various industry contexts.

Bitcoin, a cryptocurrency that uses blockchain technology to record transactions on a decentralized public ledger without the need for intermediaries, introduced blockchain technology in 2008 (Nakamoto, 2008). Since that time, blockchain technology has evolved beyond its original use in cryptocurrencies and has become a new type of decentralized database architecture (Yli-Huumo et al., 2016). Blockchain is a distributed ledger that enables several parties to agree on and keep a shared record of transactions via a peer-to-peer network (Crosby et al., 2016). Cryptography protects each transaction, links it chronologically to

previous blocks, and stores it on all nodes within the network (Zheng et al., 2017). Even without a central authority, these records remain unchangeable, traceable to their origin, and difficult to tamper with (Yli-Huumo et al., 2016).

The decentralized nature, transparency, and trustless execution of blockchain have generated interest in applications that go beyond payments (Beck et al., 2018). The system's capacity to offer unified and accurate information accessible to all parties involved makes it highly suitable for enhancing transparency in areas such as supply chain management (Kannengießer et al., 2016). Blockchain technology has the potential to resolve existing issues with transparency in e-invoicing. It enables buyers, suppliers, and other entities to verify information on a distributed ledger independently (Tönnissen & Teuteberg, 2020). Blockchain technology ensures equal access and rights for all parties involved, while also eliminating centralized control and the possibility of single points of failure or manipulation (Yli-Huumo et al., 2016). Compared to traditional centralized databases, this enhances transaction transparency, auditability, and resilience against errors or fraud (Beck et al., 2018).

The adoption of electronic invoicing has been increasingly popular among multinational corporations (MNCs) in Nigeria due to its advantages in terms of efficiency, cost reduction, and automation of corporate operations (Adeyeye et al., 2020). Nevertheless, the absence of openness continues to be a significant obstacle. Nigeria, as an emerging economy, poses challenging conditions for multinational corporations (MNCs) due to factors such as policy fluctuations, foreign exchange instability, and infrastructure deficiencies (Okafor et al., 2017). E-invoicing allows multinational corporations to optimize their operations in Nigerian subsidiaries as well as with trading partners (Adeyeye et al., 2020). Nevertheless, the majority of local e-invoicing platforms continue to be centralized ledgers that are under the authority of private vendors. This arrangement provides limited transparency to both buyers and suppliers (Okafor et al., 2017).

Multi-national corporations (MNCs) that operate in many countries encounter challenges in ensuring transparency when reconciling transactions between proprietary e-invoicing ledgers that do not have interoperability. Resolving errors or disagreements becomes challenging in the absence of a shared audit trail that is accessible to all parties involved (European Commission, 2019). This hampers the ability to meet the growing need for transparency in multinational corporations' home countries, as stated by Efionayi-Mäder et al. (2021). Ensuring transparency is crucial for multinational corporations (MNCs) operating in high-risk emerging markets. This is necessary to minimize compliance risks arising from the actions of local subsidiaries, which have the potential to harm their corporate reputation (Eweje, 2006). However, the existing centralized e-invoicing methods provide insufficient supervision for headquarters to oversee intra-company trading involving Nigerian branches (Okafor et al., 2017). This emphasizes the necessity for inventive measures to enhance transparency in electronic invoicing systems that facilitate multinational corporation activities in Nigeria.

**Overview of E-Invoicing System**

E-invoicing is the process of electronically exchanging invoices between firms, which allows for the automation of ordering and payment procedures. Historically, electronic invoicing was dependent on exclusive platforms that were under the authority of individual organizations (Tung et al., 2019). Nevertheless, the absence of interoperability across these isolated systems resulted in inefficiencies (OECD, 2019). In response to this issue, numerous governments have established national e-invoicing frameworks to regulate the forms and procedures within their respective territories (Celik et al., 2020). One example is the Nota Fiscal Eletrônica system in Brazil, which enables seamless electronic invoicing between companies and government institutions (Diniz et al., 2014). Italy's Sistema di Interscambio network enables electronic billing between enterprises and tax authorities (Agnoli et al., 2014).

Conversely, the European Union's Directive 2010/45/EU established standards for compatible electronic invoicing in order to facilitate international trade (European Commission, 2010). E-invoicing systems consist of three primary components: an invoice registry, a submission server, and a delivery network (Tung et al., 2019). The registry verifies and archives invoices issued by firms. The submission server is responsible for receiving electronic papers in standard formats. Finally, the delivery network facilitates the transportation of bills between commercial partners (Tönnissen & Teuteberg, 2020).

Adopting e-invoicing in a firm offers several advantages, such as reducing processing costs, improving payment cycles, and automating reconciliation (Celik et al., 2020). The lack of a shared audit trail visible to all stakeholders has been a significant problem for shareholders in the industry (Yli-Huumo et al., 2016). The adoption of e-invoicing has revolutionized business operations for companies globally, enabling the seamless electronic transmission of invoices.

**Components of E-Invoicing**

There are basically three (3) essential components that form the foundation of e-invoicing system. These components work together to facilitate the electronic process of ordering, billing, and payment between the trading partners. Each of the component, play a crucial role in supporting the complete workflow of digital invoicing. Attaran & Gunasekaran (2019) provide an explanation of the components of e-invoicing stated below;

1. The Submission Server

This serves as the entry point for electronic invoices and its responsible for receiving invoiced documents submitted by businesses and then validating the contents prior to registration (Celik et al., 2020). This process includes verifying the syntactic validity of the file structure as well as the data elements mandated in the e-invoicing (Tönnissen & Teuteberg, 2020).

2. The Delivery Network

This facilitates the exchange of electronic invoices between trading partners after registration in the centralized registry (Tung et al., 2019). On demand, the delivery network securely delivers registered invoices and associated documents to recipient entities (Celik et al., 2020).

Upon retrieval requests initiated by recipients, the delivery network routes archived invoices from the registry through various hubs and gateways, depending on the parties involved (Diniz et al., 2014; Okafor et al., 2023).

3. The Invoice Registry

The invoicing register, serves as the central repository for all electronic documents exchanged through the e-invoicing network (Tung et al., 2019). It serves to authenticate issued invoices and store the underlying metadata and transaction records in an organized manner (Celik et al., 2020).

**Transparency Of E-Invoicing**

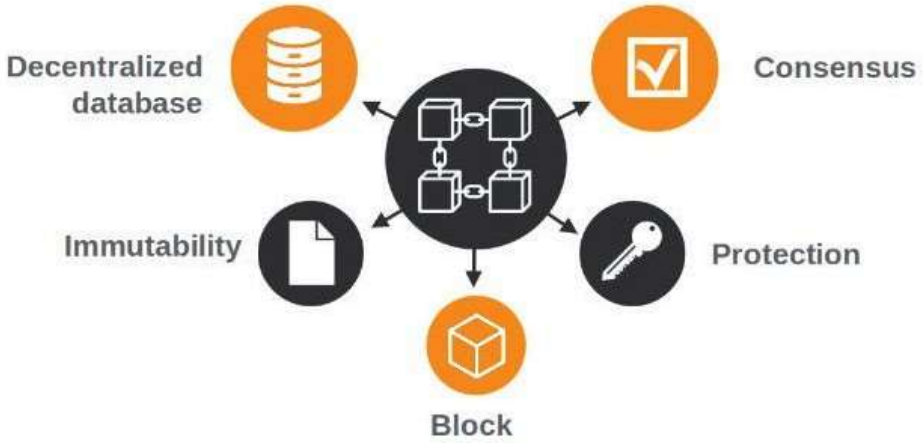
Conventional electronic invoicing is dependent on centralized ledgers that are under the authority of either private vendors or governments (Yli-Huumo et al., 2016). Although this paradigm improves efficiency, it lacks transparVency for buyers and suppliers, who are dependent on intermediaries (Kannengießer et al., 2016). The absence of a common audit trail diminishes openness and obstructs the resolution of disputes when there are discrepancies in records (Tönnissen & Teuteberg, 2020). Without independent verification, it is difficult to uncover and remedy any errors or fraudulent activity (European Commission, 2019). This erodes the confidence necessary for digital transactions between trading partners (Beck et al., 2018).

The lack of compatibility between exclusive ledgers also results in the formation of isolated data repositories, which hinders the capacity to have a comprehensive view of the entire process (OECD, 2019). Blockchain has the potential to solve these gaps by providing all stakeholders with equal access to an unchangeable record, according to its distributed consensus approach (Yli-Huumo et al., 2016). By acting as a publicly accessible ledger, it offers a unified and reliable record, enhancing transparency in contrast to separate centralized databases (Kannengießer et al., 2016). Furthermore, the cryptographic audit trail of blockchain acts as a deterrent against tampering, thereby reinstating confidence by ensuring verifiability (Crosby et al., 2016).

**Blockchain Technology**

First announced in 2008 alongside bitcoin, blockchain is a decentralized system that enables direct transactions between peers without the need for intermediaries (Nakamoto, 2008). The system operates by disseminating an ever-expanding collection of transaction records among a network of participating nodes, achieving agreement on updates in a decentralized manner (Zheng et al., 2017). Cryptography secures each transaction, links it to previous blocks, and creates an unchangeable record that everyone can verify (Crosby et al., 2016). The fundamental characteristics of blockchain, including decentralization, transparency, and security, have generated interest that extends beyond the realm of cryptocurrencies (Beck et al., 2018). The shared ledger form of this technology is particularly suitable for areas that require the ability to audit and establish confidence

among parties that do not trust each other (Kannengießer et al., 2016). The blockchain technology architecture as developed by Radovic & Bacanin (2021) is illustrated in figure 1.




However, with time, it has become a technology that is having a great impact on modern society due to its transparency, decentralization, and security characteristics. Blockchain technology has the potential to transform the way we live, interact, and perform business. Nowadays, academics, industrialists, and researchers are aggressively investigating different aspects of blockchain as an emerging technology. Internet of Things (IoT) devices have used this technology to authorize, authenticate, and audit data.

**Blockchain Technology-Based E-Invoicing**

E-invoicing has become a crucial approach for achieving cost reduction as organizations strive to optimize their financial supply chain. This statement is especially important for organizations that handle a large number of documents. Currently, these organizations must carefully examine their internal processes to free up their tied financial resources. This is necessary due to the lack of available credit and the high cost of borrowing (Hugos, 2018). Improving the financial supply chain's efficiency necessitates the use of electronic data, specifically electronic invoicing, commonly known as e-invoicing. According to Hugos (2018), companies believe that the benefits of cost reduction outweigh any potential expenses or inconveniences that may arise from changing their operational methods.

E-invoicing is an automated solution that covers the entire invoice processing process, from invoice creation to final payment. The deployment of an automated system efficiently reduces the need for human intervention by handling tasks such as data entry and harmonization. As a result, eliminating labor-intensive duties brings significant financial advantages. The adoption of e-invoicing eliminates the need for traditional paper invoices, reducing costs associated with printing, mailing, envelopes, physical storage, and transferring to a paperless system. This successfully reduces both direct and indirect expenses. Therefore, this adoption not only conforms to ecological principles but also offers a financially sensible alternative (Bruno, 2019). The human input and processing of data are prone to errors, which can lead to significant disparities, disagreements, and the need for later corrective measures. Automated validation checks specifically design e-invoicing solutions to reduce errors and ensure the accuracy of financial data (Marak & Pillai, 2021).

E-invoicing sometimes involves the use of automated approval procedures, which speeds up the approval process and subsequent payment. The improved efficiency mentioned here helps reduce the administrative effort and resource allocation involved in approving bills, leading to faster payment cycles and improved cash flow. E-invoicing solutions provide immediate access to relevant information about the current status of invoices and financial activities. This system enhances visibility, resulting in enhanced decision-making, decreased time for status inquiries, and expanded reporting capabilities. Consequently, this system optimizes administrative processes (Marak & Pillai, 2021; Moretto & Caniato, 2021).

The use of e-invoicing allows for fast and accurate payment processing, improving the relationship between suppliers and their counterparts. Reducing payment delays and disputes improves supplier

interactions, thereby reducing the administrative overhead of resolving issues. E-invoicing solutions often have built-in compliance verification tools and maintain detailed records of audit trails. The aforementioned approach improves compliance with tax requirements and simplifies audit preparedness, potentially reducing audit-related expenses. You can cite Fairchild (2016) as an academic resource for further investigation and examination. E-invoicing solutions streamline routine administrative activities, allowing organizations to reallocate their administrative resources to more strategic and value-added initiatives. These endeavour may encompass many activities such as financial analysis, supplier negotiations, and process enhancements (Olaleye et al., 2023).

**Invent of Blockchain Technology in Nigeria**

Nigeria has been a front-runner in cryptocurrency adoption in Africa, mostly because of its youthful and technologically adept population (Oke & Labeodan, 2022). Anticipations in 2021 indicated that over thirteen (13) million Nigerians owned cryptocurrency, with monthly trading volumes surpassing four hundred million ($400 million) dollars (Fasan, 2022). Nevertheless, the presence of regulatory ambiguity continues to be a challenge, as the central bank implemented a prohibition on banks aiding cryptocurrency transactions in 2021 (Oke & Labeodan, 2022). In addition to payments, local start-ups are investigating the possible applications of blockchain technology in many industries. Businesses such as Farmcrowdy are employing distributed ledgers in agriculture to optimize the process of transactions between farmers and off-takers (Nwosu et al., 2021). Helium Health is a healthcare venture that seeks to use blockchain technology to manage electronic medical information and process insurance claims (Adejumo, 2021). The government acknowledges the strategic significance of blockchain technology, as evidenced by the National Information Technology Development Agency's introduction of a regulatory sandbox and initiatives aimed at supporting domestic projects (Oke & Labeodan, 2022).

Infrastructure difficulties, such as unreliable power supply and limited internet access, hinder the adoption of technology (Nwosu et al., 2021). Skills shortages hinder the development of blockchain, as local colleges are just beginning to offer courses in this field (Adejumo, 2021). Nigeria's start-up environment is showing promise for decentralized technology, as indicated by its thriving ecosystem and active involvement of policymakers (Fasan, 2022). By implementing favourable policies and providing comprehensive skills training, blockchain technology has the potential to revolutionize critical sectors and position Nigeria as a front- runner in Africa.

**Blockchain-Based E-Invoicing in Nigeria**

It is clear that multinational businesses operating in emerging economies such as Nigeria would require new solutions to enhance oversight and transparency in their widely spread business networks. Even though the current centralized models of e-invoicing digitize some processes, they don't provide the visibility and auditability needed to effectively reduce risks like fraud, ensure tax compliance, and protect corporate reputations for large companies with operations in many countries. If carefully linked with public and private ledgers, blockchain's revolutionary distributed ledger technology (figure 2) as proposed by Liu (2018), has the potential to revolutionize e-invoicing systems. This innovative distributed ledger concept has the potential to fill in the gaps in the current frameworks by enabling a shared system of record that is accessible to all parties involved.

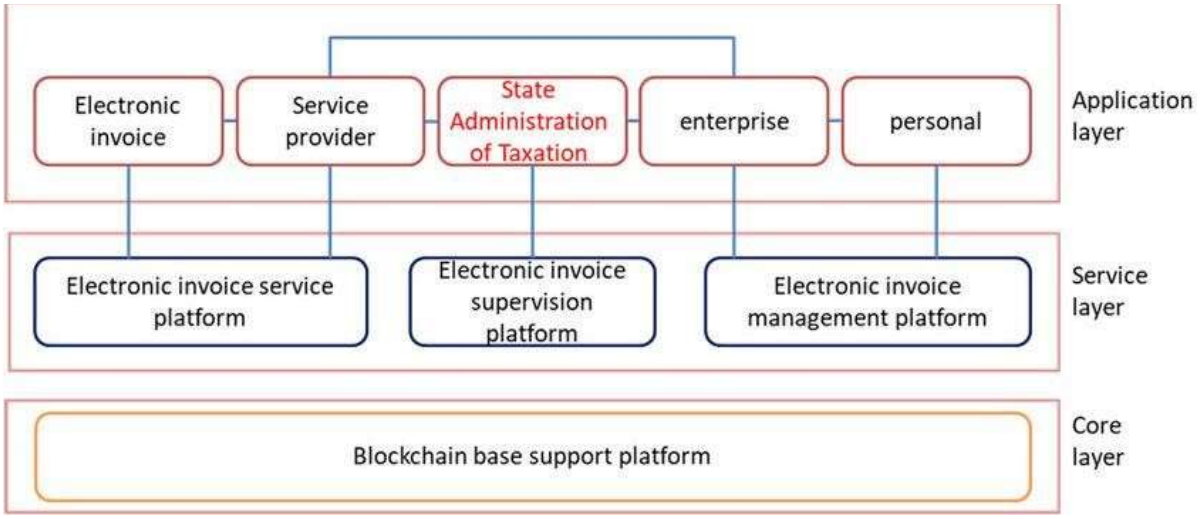



Figure 2: Blockchain-Based Electronic Invoicing System (Source: Liu, 2018)

An issue of significant concern is the absence of a unified ledger, as private networks function as separate entities from public systems (Okafor et al., 2017). This hinders the level of openness required for intricate reconciliations (Adeyeye et al., 2020). Blockchain, as described by Zheng et al. (2017), creates a decentralized shared database that permanently records verified transactions on interconnected digital blocks. Therefore, it provides a unified and accessible system of documentation, visible to all parties involved (Kannengießer et al., 2016). Blockchain technology has the potential to enable more dependable compliance tracking and dispute resolution between multinational corporations (MNCs) and their Nigerian business partners. Nwosu et al. (2021) achieve this by giving buyers, suppliers, and regulators unified access to an unchangeable record of transactions. The presence of a cryptographic audit trail serves as a deterrent to fraudulent billing techniques that currently weaken supervision (Crosby et al., 2016).

Furthermore, smart contracts have the capability to automate conditional payments and incorporate regulatory reporting by utilizing programmable transaction rules (Yli-Huumo et al., 2016). This has the potential to optimise tax remittance procedures that currently necessitate costly manual reconciliations (Oke & Labeodan, 2022).

**Benefits of Blockchain Powered E-Invoicing**

1. Blockchain technology has the potential to overcome the existing limits of e- invoicing systems. If applied wisely, it can offer several distinct advantages through its innovative distributed ledger model:
2. By providing all parties with equal access to an unchangeable record of transactions, blockchain offers a unified and transparent source of information that is available to everyone. This enhances supervision in comparison to separate centralized databases and resolves discrepancies across non-integrated ledgers (Yli-Huumo et al., 2016).
3. Blockchain technology has the potential to overcome the existing limits of e- invoicing systems. If applied wisely, it can offer several distinct advantages through its innovative distributed ledger model:
4. Nwosu et al. (2021) record the time-stamped digital fingerprint of each authenticated transaction. This mitigates concerns regarding vulnerabilities caused by the absence of centralized control (Zheng et al., 2017).
5. It enables the automation of conditional invoice payments and regulatory compliance reporting using programmable transaction rules (Okafor et al., 2017). This process simplifies laborious manual reconciliation operations and minimizes conflicts that impede commercial transactions (Adejumo, 2021).
6. By utilizing distributed consensus, blockchain offers interoperability across public and private ledgers, overcoming the limitations of existing isolated models (Oke & Labeodan, 2022). This

network effect integration allows for full use of big data analytics capabilities.

## METHODS

The researchers developed a web-based platform, scripted with JavaScript, structured with HTML, and styled through CSS. Bills were generated through user interfaces, with details such as owner name and ID providing characteristics for smart contracts. These self-executing contracts, embed the terms of buyer-seller agreement directly into their code, enabling secure transactions and agreements between dispersed, anonymous parties without relying on centralized authorities or legal frameworks. To ensure data security, the collected data were stored on the Ethereum blockchain. Ethereum establishes a peer-to-peer network for securely executing and verifying application code, or smart contracts. Contracts were thoroughly tested on separate networks before deployment on the main network. Finally, Solidity was employed for the construction of the contracts while Remix IDE facilitated its creation and deployment, allowing the establishment of transaction record chains as well as the execution of business logic within the blockchain system.

## RESULTS AND DISCUSSION

In this phase, the website's Frontend leveraged on Web3, while JavaScript library facilitated user interaction with the Ethereum blockchain. Initially, the researchers fetched the deployed contract on the blockchain and subsequently generated an instance of it. After creating the instance, it populated parameters with pertinent invoice details such as the receipt number, total amount, seller, and buyer identifications. After setting the parameters, the system described the corresponding events and invoked its emitted functions, making the variables immutable and tamper-proof when stored in the blockchain. This transparent and trustworthy system allowed open access to all the stored blockchain data.

The Frontend encompassed the features (user authentication, real-time updates, and notifications) in order to ensure seamless interaction with the blockchain contract. With an embedded user-friendly interface, it allowed for easy navigations and interactions with the contract, as well as serving as a critical conduit between users and the blockchain contract.

The smart contract for the invoice generation system was developed using Solidity, a language tailored for the Ethereum blockchain. RemixIDE, a web-based integrated development environment, facilitated contract development, testing, and deployment. Ethereum Ropsten TestNet and Ganache were the chosen blockchains for implementation, offering an environment for contract testing and local Ethereum simulations respectively.

The website furnished an intuitive interface offering features such as inventory and order management alongside invoice generation to retailers. This comprehensive functionality,

empowered them with inventories and order oversight, aiding stock management and preventing stockouts. Moreover, real-time updates, notifications, and reports enhanced decision-making capabilities.

In summary, the amalgamation of the smart contract and website Frontend yielded a robust and secure invoice management system, capable of automating invoicing processes, enhancing efficiency, and reducing costs for businesses. The user-friendly interface made the system accessible to businesses of various scales, further amplifying its utility and adaptability potentials.

```
// Smart Contract in Solidity for creating and paying bills
// Define the contract contract BillContract {
// Structure to represent a bill struct Bill {
address payable payee; uint amount;
string memo; bool isPaid;
}
// Initialize an empty list of bills Bill[] public bills;
// Initialize a bill counter to 0 uint public billCounter;
// Event to track bill creation
event BillCreated(uint billId, address payee, uint amount, string memo);
// Event to track bill payment event BillPaid(uint billId);
// Function to create a bill
function createBill(address payable _payee, uint _amount, string memory _memo) public {
// Increment the bill counter billCounter++;
// Create a new bill
Bill memory newBill = Bill({ payee: _payee,
```

```
amount: _amount, memo: _memo, isPaid: false
});
// Add the new bill to the list of bills bills.push(newBill);
// Emit an event "bill created"
emit BillCreated(billCounter, _payee, _amount, _memo);
}
// Function to pay a bill
function payBill(uint _billId) public payable {
// Fetch bill from list of bills using bill ID Bill storage bill = bills[_billId - 1];
// Check if the bill is unpaid
require(!bill.isPaid, "Bill has already been paid");
// Check if the sent value is equal to the bill amount require(msg.value == bill.amount, "Incorrect payment amount");
// Transfer the bill amount to the payee's address bill.payee.transfer(msg.value);
// Mark the bill as paid bill.isPaid = true;
// Emit an event "bill paid" emit BillPaid(_billId);
}
}
```

This Solidity code initialized a smart contract for creating and paying bills. It defined a structure for representing bills, initializing empty list of bills, and a bill counters. The createBill function allowed users create new bills by providing the payee's address, bill amount, and memo. The payBill function enabled users to pay bills by providing the bill ID and sending the exact bill amount(s). If the payment is successful, the bill is marked paid, and transferred to the payee's address.

## CONCLUSION

This study presented a comprehensive examination of an invoice management system that integrates a smart contract, developed through Solidity and a user-friendly website Frontend while leveraging on Web3 technology. By harnessing blockchain capabilities, the system ensures immutable and tamper-proof storage of invoice data, fostering transparency and trustworthiness. The Frontend not only facilitates seamless interaction with the blockchain contract but also provides essential features such as user authentication, real-time updates as well as notifications. This amalgamation of technology, empowers businesses with efficient invoice automation, inventory management, and decision-making support. Finally, the system offers a scalable solution adaptable to businesses of various sizes, promising enhanced efficiency and reduced operational costs in the invoicing process.

## RECOMMENDATIONS

The following recommendations are made from the study;

1. Implementing the proposed system will streamline invoicing processes, reduce manual labor and the associated costs. By automating tasks such as invoice generation and management, businesses can allocate resources more effectively.
2. Leveraging blockchain technology ensures data immutability and tamper- proofing, enhancing transparency in transactions. This can foster trust among stakeholders, including customers, suppliers, and regulatory authorities.
3. The system's integrated features for inventory and order management provide businesses with real-time insights, aiding in stock management and decision- making. This can help prevent stockouts, optimize inventory levels, and improve overall operational efficiency.
4. Developers can learn from this study and adhere to best practices in smart contract development, ensuring security, efficiency, and reliability.
5. Developers should prioritize user experience and interface design to ensure seamless interaction with blockchain-based applications.
6. The researchers also recommend for further exploratory studies on strategies for addressing security and privacy concerns associated with blockchain technology, particularly concerning sensitive invoice data should be carried as well as conducting studies to understand the factors influencing adoption and acceptance of blockchain-based invoice management systems.

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