PROJECT ON

THE USE OF ETHEREUM NETWORK IN MANAGING VEHICLE REGISTRATION IN NIGERIA

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CERTIFICATION

This is to certify that this study was carried out by **OBAFEMI TOBILOBA BOLADE** in the department of Computer Engineering, University of Benin, Nigeria in partial fulfillment of the requirement for the award of **Bachelor Degree in Engineering (B.Eng)** in Computer Engineering.

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DEDICATION

This project is dedicated to GOD Almighty for his faithfulness, benevolence, wisdom and supremacy and to my parents and siblings for their love and support.

ACKNOWLEDGMENT

First and foremost, praises and thanks to God, the Almighty for His showers of blessing during this project. I would like to express my sincere gratitude to my project supervisor, Engr. Dr. Dele for providing invaluable guidance during the project.

My appreciation also goes to my parents Mr. and Mrs. Obafemi, my siblings, family and friendswho were there for me all through.

TABLE OF CONTENTS

Table of Contents

LIST OF FIGURES

ABSTRACT

Although centralized institutions, like governments, can use blockchain technology to increase the safety and security of sensitive data, this technology also permits the emergence of decentralized business models. The proposal to create a car registration system in Nigeria that can enhance interoperability between governmental agencies and might be expanded to a cross-borders system is described in this project work and is based on the Ethereum blockchain network. The suggested system takes care of all car registration-related procedures, including changing a vehicle's ownership status and registering it.

As the car registration information is supplied to each government agency in a single decentralized system, this approach can facilitate information interchange among several states.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

A blockchain is a growing list of records, called *blocks*, which are linked together using crptography. (Morris, David Z, Popper, Nathan, May 2016).

In recent times, there has been growing need to computerize the operations of big establishments both private and public to increase their overall efficiency. This is achieved by using computers to store, process and retrieve information as well as generate report. Computer program and manuals are designed to cover all aspects of particular task in realizing the objective and as technology keeps advancing the use of blockchain technology can be used to replace this as it is more efficient.

The core of a decentralized cryptocurrency network is the blockchain, an append-only data structure that stores every transaction ever executed in the network. Every block in the blockchain contains the hash of its predecessor. This creates a chain of blocks reaching back to the first block, the foundation block. Because subsequent blocks depend on each other, it is not feasible to change a block retrospectively when it was present for a longer time in the chain. This makes it very hard to conduct double-spending attacks.

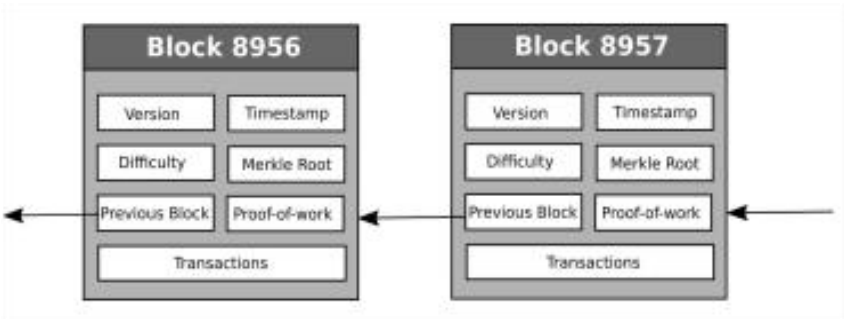

Fig 1: The structure of a block in a blockchian.

In a worst-case scenario, blockchain technology might offer a decentralized set of services that compete with those provided by the government, such as property registration, citizen registration, and even a financial system replacement that might make the majority of the work done by the government useless.

The more reason a blockchain is often compared to a ledger is because of the process of recording every transaction in sequence.

1.2 TYPES OF BLOCKCHAIN.

PUBLIC BLOCKCHAIN

A distributed ledger system without constraints and permissions is known as a public blockchain. Anyone with internet access can sign up on a blockchain platform to join the network as an authorized node and become a part of the blockchain. It is permitted for a node or user who is a part of the public blockchain to view recent and old records, confirm transactions or complete proof-of-work for an incoming block, and engage in mining. The mining and trading of

cryptocurrencies is the most fundamental usage of public blockchains. As a result, Bitcoin and Litecoin blockchains are the most widely used public blockchains. If users adhere to security policies and procedures to the letter, public blockchains are generally secure. However, it is only dangerous when the participants don't really adhere to the security rules.

Examples: Bitcoin, Ethereum, Litecoin.

PRIVATE BLOCKCHAIN

A restricted or permission blockchain that may only be used in a closed network is referred to as a private blockchain. Private blockchains are typically utilized inside of businesses or organizations where only a small group of people are allowed to participate in a blockchain network. The governing organization controls the level of security, authorizations, permissions, and accessibility. Therefore, private blockchains are used similarly to public blockchains but have a constrained and tiny network. Private blockchain networks are used for asset ownership, digital identity, supply chain management, voting, and other purposes.

Examples: Multichain and Hyperledger projects.

HYBRID BLOCKCHAIN

A hybrid blockchain combines the features of public and private blockchains. It makes use of both the private permission-based system and the public

permission-less system aspects of blockchains. Users can manage who has access to what data stored in the blockchain with the help of such a hybrid network. Only a specific subset of the blockchain's data or records can be made public, keeping the rest secret and confidential. Users can simply combine a private blockchain with several public blockchains thanks to the flexibility of the hybrid blockchain technology. A hybrid blockchain's private network is typically used to verify a transaction. However, users can also publish it on the open blockchain in order to be confirmed. The hashing is increased and more nodes are used for verification on public blockchains. As a result, the blockchain network's security and transparency are improved.

Dragonchain is a prime example of a hybrid blockchain.

CONSORTIUM BLOCKCHAIN

A consortium blockchain is a semi-decentralized kind in which a network of blockchains is controlled by multiple organizations. Contrary to what we observed with a private blockchain, which is controlled by only one company, this is not the case. In this kind of blockchain, multiple organizations may function as nodes, exchanging data or engaging in mining. The typical users of consortium blockchains include financial institutions, governmental bodies, etc.

Examples: Energy Web Foundation, R3 e.t.c.

1..3 VEHICLE REGISTRATION IN NIGERIA.

Vehicle Registration in Nigeria began over 100 years ago and the records have been essentially manual which in turn has not help to improve the efficiency of general automotive services in recent years (B. Ogbe, 2018).

The motor licensing office in Abuja only focuses on the registration and inspection of vehicles; it does not provide any additional services, such as vehicle tracking, management of learner's permits and driver's licenses, observation of the activities of drivers and their vehicles, or the recording of accident and crime reports.

By asking applicants to personally deliver the certified copy of the resident's registration and other documentation, the local, state, and district offices that handle vehicle registrations burden applicants. Vehicle registration involves manually recording the information about each vehicle, which can be anything from a car to a bus to a truck and heavy machinery later on, on ledgers while also keeping track of other relevant data like registration, roadworthiness test certificates, change of ownership, engine and chassis numbers, and the expiration of a driver's license. Due to the tremendous inefficiency of this method, information could not be recovered when ledgers were damaged or lost, which happens frequently.

1.4 PROBLEM STATEMENT

A highly populous nation like Nigeria where the number of car owners rises yearly makes the registration of motor vehicles a slow and occasionally challenging process. The manual technique of writing these documents has made keeping track of licenses and their registrations a laborious task that has led to record loss, damage, and improper filing.

According to Vanguard news on June 2, 2021; Kaduna: FRSC clamps down on vehicles with expired documents, old number plates.

The FRSC Sector commander in Kaduna, Hafiz Muhammed explained that having registered vehicles and licensed number plates was a critical importance to national security, especially at such trying times. He also mentioned that up till this moment a lot of unregistered vehicles including tricycles and motorcycles still ply our roads and perpetrates crimes unnoticed. Furthermore, he explained that old vehicles number plates had seized to exist in the FRSC database.

Some of the problems that are being encountered in managing vehicle registration in Nigeria are:

Participation of Unauthorized Officers: According to my observations, unauthorized officers are involved in vehicle registration especially in the registration of illegal vehicles which can encourage fraud.

Wrong Charging of Fees: The officer in charge may charge a wrong bill to vehicle owners which may be as a result of underassessment or over assessment of vehicles. This could be with motive to commit fraud or as a result of mistake on the part of the officer.

Wrong State Allocation: Staff under a particular state motor vehicle licensing office indulges in registering of vehicles that does not belong to their state.

Improper Accounting: There is a tendency of the cashier involved in handling of income generated to make mistake during this process, thus having some measures of inaccuracy in the work.

Poor Record Management: There is difficulty at times in tracing a record/information or cautioning a vehicle owner due to improper information keeping as a result of carelessness or volume in the size of record kept.

Metal/Manual Labor: This involves the use of strength and brain of the body. The officer in charge goes through mental labor because he has to sort the records of the entire vehicle in his domain of jurisdiction. He suffers from manual labor because he has to manually write all the records.

Excess Time Consumption: There is excessive time consumption because the officer has to write and enter information of the vehicle after the person whose vehicle is to be registered has paid for the licensing of his/her vehicle and also, it

takes a lot of time to find the information of the vehicle owner when it is required for.

Indulges Crime: An unregistered vehicle cannot be traced or tracked down when it is used in crime situations like robbery, murder etc.

All these are problems pertaining to vehicle registration in Nigeria, and this proposal reveals solutions to meet these problems.

AIM OF WORK

The aim of this project is to use Ethereum network (blockchain) in managing vehicle registration in Nigeria

OBJECTIVES

This work has the objective to evaluate and understand the impact of a blockchain (Ethereum) vehicle registration on the currently implemented registering processes. As blockchain technology enables for maintaining registries between untrusted, the implementation of new processes, taking advantages of blockchain (Ethereum) technology, will be considered. Therefore we propose an objective as follows:

- Designing the User Interface that will collect vehicle registration storing it on the ethereum blockchain.

- Writing the Smart Contract codes using ethereum blockchain network that will support the design process.

1.5 SCOPE OF WORK

The scope of this project work is limited to using Ethereum blockchain network in managing vehicle registration in Nigeria, using Ethereum smart contract and using a programming language (Solidity) to write the smart contract code to perform this work.

Although this project can be applied beyond vehicle registration such as storing the information of birth and death rate using the same distributed ledger (Blockchain) system as this project. This project can in turn be accepted anywhere in the world because of its inflexibility.

1.6 RELEVANCE OF STUDY

Managing vehicle registration in Nigeria using the ethereum blockchain network which is a decentralized mode of record keeping is almost without limit. From greater individual privacy and heightened protection to lower processing charges fewer errors, ethereum blockvhain network era may very well see applications in the following:

Improved accuracy by disposing of human involvement in verification: Transactions in the blockchain network are approved through a community of heaps or thousands and thousands of computers. This removes almost all human involvement inside the verification process, ensuring in much less human error and a more accurate record of information

Cost elimination by doing away with third party engagement and verification: Basically, many clients pay a financial institution to verify a transaction or a notary to sign a document. Blockchain removes the necessity for third-party verification and, with it, their associated costs. Businesses and agencies incur a small fee each time they accept bills using credit-cards, for example, due to the fact that banks must process the transactions. Ethereum, on the other hand, does not have a central authority hence no charges or costs related to the transaction.

Decentralization makes it tougher to tamper with: There is no longer a single location where the Ethereum blockchain stores all of its data or records. Instead, the blockchain is distributed and copied by a network of computers.

Secured verifications of registered vehicles: The transaction is added to the blockchain as a block once a machine has confirmed it. On the blockchain, each block contains both its own unique hash and the hash of the block that came before it. The hash code of a block changes when the facts on that block are altered in any

way, while the hash code of the block after it does not. It is very difficult to change entries on the blockchain without notice because of this difference.

Transparency: Although the records of specific persons that are housed on the blockchain network are secure, the technology itself is in a public setting. Simply expressed, this means that users on the blockchain network are free to control the code anyway they see fit, provided that they have the support of the majority of the computational authority on the network. Additionally, keeping information on the blockchain makes it much harder to tamper with data.

Secured and safe records of registered vehicles: Records of registered automobiles are safe and secure since they may be viewed at any time and remain accurate and complete.

Less Harassment of Agencies Related to Vehicle Registration: Any vehicle registered on the blockchain can be quickly accessed for inspection, solving the problem of bothering a vehicle owner on the road, which may cause time to be delayed and other concerns.

However, this project work brings less fraudulent activities in the society as regarding to vehicle registration. As for a car being registered, there shouldn't be any problem in the future as every detailed information about the registration is secured and recorded, and can be accessed on the Ethereum blockchain for clarification at any point in time.

CHAPTER TWO

LITERATURE REVIEW

2.1 ETHEREUM BLOCKCHAIN AND SMART CONTRACT

2.1.1 ETHEREUM BLOCKCHAIN

Ethereum is a blockchain platform with its own cryptocurrency, called Ether (ETH) or Ethereum, and its own programing language called solidity. As a blockchain network, Ethereum is a decentralized public ledger for verifying and recording transactions (Jake Frankenfield, 2018).

Ethereum is essentially a single decentralized system that runs a computer called the Ethereum Virtual Machine (EVM). Each node holds a copy of that computer, meaning that any interactions must be verified so everyone can update their copy. It is a blockchain based cryptocurrency system that aims to provide a decentralised general purpose computer. The programs that run on this decentralised computer are usually referred to as smart-contracts and are automatically enforced through the blockchain validation process that is carried out by all full nodes independently. Full nodes are those that download and validate the whole blockchain, these nodes do not need to trust any other node, since they can validate the whole transaction history. It was created to enable developers to build and publish smart contracts and distributed applications (dApps) that can be used without the risks of downtime, fraud, or interference from a third party.

Ethereum blockchain network is powered by the Ether token that enables users to make transactions, earn interest on their holdings through staking, use and store nonfungible tokens (NFTs), trade cryptocurrencies, play games, use social media and so much more. Ethereum is considered to be the internet's next step. If centralized platforms like Apple's App Store represent Web 2.0, a decentralized, user-powered network like Ethereum is Web 3.0. This "next-generation web" supports decentralized applications (DApps), decentralized finance (DeFi) and decentralized exchanges (DEXs), for instance.

It is a permissionless blokchain which allows for the creation and development of applications without oversight from a central authority. The blockchain technology behind Ethereum is just like every other cryptocurrency (Imagine a long chain of blocks). All of the information contained in each block is added to every newly-created block with new data. Then, an identical copy of blockchain is distributed throughout the network.

This blockchain is validated by a network of automated programs that reaches a consensus on the validity of transaction information. Changes cannot be made to the blockchain unless the network reaches a consensus which makes it highly secured.Consensus is reached using an algorithm called a consensus mechanism. Ethereum uses the proof-of-stake algorithm, which involves validators who are network participants to create new blocks and work together to verify the information they contain. The block contains information about the state of the

block, a list of attestations (a validator's signature and vote on the validity of the block), transactions, and much more.

2.1.2 SMART CONTRACT

A smart contract is a special account that stores executable code together with its associated data and an account balance on the blockchain (Ahmed Chahbaz, 2018).

Ethereum smart contracts are key innovation in blockchain, they are self-executing contracts that verify, facilitate and enforce transactions on the blockchain.

Smart contracts have an address (a public key) and are created by transactions. Transactions are also used to interact with a contract on the blockchain by sending money to its account balance or by executing code. To execute the code of a contract, a function call containing the functions name and its parameters is binary encoded and sent to the contract in the data field of the transaction. It is basically a coolection of code (it's functions) and data (it's state) that resides at a specific address on the Ethereum blockchain.

Smart contracts are a type of Ethereum account; this means they have a balance and can be the target of transactions. However, they are not controlled by a user; instead they are deployed to the network and run as a program. User accounts can then interact with a smart contract by submitting transactions that execute

function defined on the smart contract. Smart contract can define rules, like a regular contract, and automatically enforce them via the code. Smart contracts cannot be deleted by default, and transactions with them are irreversible.

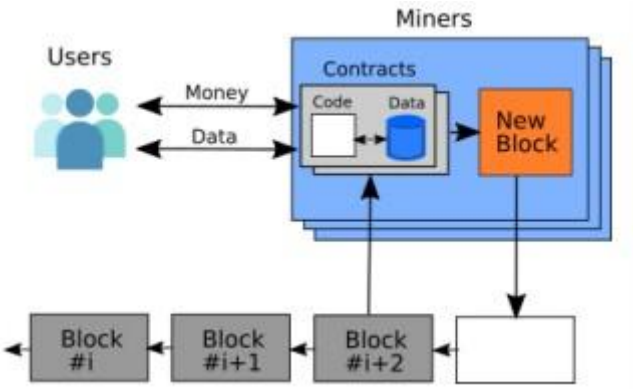

Fig 2.1: Execution of Smart Contract on a blockchain.

Fig 2.1 illustrates the interaction of externally owned accounts (users) with a contract.

Every time a contract receives a message from another contract or a transaction from a user, it can receive ether or execute a function that is specified in the data field. In the same way, the contract can send money from its balance to other accounts or execute functions on other contracts through broadcasting of messages. (K. Delmolino et al, 2015).

Smart contracts are applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third party interference.

The permissionless property of the Ethereum blockchain enables anyone to write smart contract and deploy it to the network. Deploying a smart contract is technically a transaction, so the need to pay gas is required in the same way it is needed for a simple ETH transfer. However, gas cost for contract deployment is higher.

Since smart contracts are public Ethereum, they can be thought as an open APIs which means you can call other smart contracts in your own smart contract to greatly extend what's possible. Contracts can even deploy on other contracts.

2.2 RELATED WORKS

A number of countries have drifted towards providing a distributed ledger system like Ethereum blockchain network, which maintains and controls re

cords related to vehicles. Such an integrated system benefits stakeholders including the government, vehicle owners, insurance companies, potential buyers of vehicles, and vehicle stakeholders seeking correct information.

Some works which are related to this project proposal are considered below

Bogner et al, 2016 presented a fully decentralized sharing app. The application uses a smart contract on the Ethereum blockchain for the conclusion of rental contracts. The contract stores the description of the item together with its

rental price and deposit. The front end of the application that provides the user interface is implemented in JavaScript and HTML5.

Gaurav Nagla, 2018 proposed a reliable ledger platform to keep the record of vehicles. It stores past information of vehicles such as collision information, financial information, and transfer of ownership, repairs and life of vehicle. The system uses the blockchain to create a chain consisting of different blocks to store the individual vehicle data. The interface unit is been also develop to access the node for viewing and adding new node to the chain.

John Lilic in 2017, proposed a Peer to Peer (P2P) energy trading platform that uses Ethereum smart contracts to manage transactions between participants in a local electric power microgrid. In the system, every owner of a photovoltaic (PV) facility installs a smart meter that keeps track of the surpluses made. The smart meter then updates the available surplus for this participant on a smart contract on the Ethereum blockchain. Interested buyers from the same neighborhood can then interact with the contract to buy energy credits.

Cho Cho Htet and **May Htet** in 2012, aimed to develop a secure system for trading system. They suggested using a reliable e-commerce business model with product grading system to get the price of the product based on its quality. They developed a platform where the car owner, buyer, and other agencies like repair services must register themselves and also to know all the history of a vehicle

information which are all stored in a public blockchain network. By using the blockchain it becomes harder for the attackers to attack the system as it gets distributed over different nodes.

Brousmiche et al, 2011 presented a solution for fraud encountered in vehicle odometers, which occurs due to the lack of management over a vehicle's life cycle, and proposed Blockchain-based vehicle data and processes ledger to digitize the vehicle life cycle. In case the car faces road accidents, the insurance companies evaluate the damages and make appropriate entries in the secure car book. The vehicle at the time of purchase, along with the secure car book, can be analyzed by buyers to gain a clear picture of the vehicles history.

Muhammed Shoaib et al. in June 2020 presented a blockchain-based framework for vehicle tracking**.** The usage control model is integrated with IoT devices to continuously monitor the vehicles for certain conditions and remotely revoke access if needed. They also presented a prototype implementation of a permissioned blockchain, which was made available under the GNUv3 General Public License.

Umair Khan in November 2020, proposed a Blockchain Ethereum Technology-Enabled Digital Content: Development of Trading and Sharing Economy Data. The encrypted algorithms was incorporated in the system to make transparent transactions and also implemented on content itself to prevent from

smart forgery and hacking. The experimented results signify that the proposed method has strong potential to enhance transaction transparency by minimizing the security threats in digital content transactions.

Kishigami et al. proposed super distribution concept for Blockchain-based digital content distribution. The proposed system has no enticement for the mining calculation which means no cost can be covered if each minor calculates the hash value.

Anthony C. Eufemio et al in 2014 proposed Digix, which provides a use case for the tokenization and documentation of physical assets through its Proof of Asses (PoA) protocol. The PoA protocol utilizes Ethereum and the InterPlanetary Files System (IPFS) to track an asset through its chain of custody. This allows for the open and public verification of an asset's existence without a centralized database. Digix also offers an API allowing other applications to be built on top of their asset tokenization service.

Aasim Ullah et al. in November 2020 proposed An Electrical Blockchain-Based Prototype for Data Security of Regulated Electricity Market. A decentralized Ethereum Blockchain-based end-to-end security prototype for a regulated electricity market such as the NZEM (New Zealand Electricity Market) was proposed. This prototype aimed to enhance data security between the different layers of the current system.

Although various authors around the world have implemented the use of Ethereum blockchain in different prospective and have alighted the importance and advantage of it; but it is limited to just their work.

Reviewing related works, blockchain; majorly because of its distributed ledger system property has been of very great importance to the world economy at large as it is seen to have impacted in the development of digital technology. Ethereum as one of the most popular blockchain have been used in various countries to develop their system and technology making it more reliable and adoptable by other countries.

Implementing this work into the vehicle registration system of Nigeria will also be very essential to the development of the country for it will bring solution to problems such as fraud, insecurity, centralization etc. pertaining to the current system of registering vehicles.

This project work will further discuss more in subsequent chapters on how to implement this system into the current means of registering vehicles in Nigeria.

CHAPTER THREE

METHODOLOGY

In this section, we will be discussing about the method employed in carrying out this work.

Blockchain can store vehicle details in a decentralized and distributed database which is set up to access vehicle details. Each update of the vehicle data in one compartment will be read simultaneously in other compartments. This ensures consistent data availability across multiple departments and also addresses the problem of outdated data. With Ethereum blockchain, the authorities involved in a vehicle registration process, can easily participate in accessing and updating vehicle data based on their access to security. The solution also ensures that the most secure and complete information is stored and shared securely and economically. To further explain, let's first look at the existing system in vehicle registration process. We also looked at some basic workflows and understood how they are simplified with blockchain.

3.1 EXISTING SYSTEM

The existing vehicle registration process involves manual recording of vehicle’s information ranging from cars to buses and to trucks and heavy duty equipment on ledger and tracking other related information such as registration, road worthiness test certificate, change of ownership, engine chassis number; and expiration of road license. This process has been extremely inefficient and

recovery of information was not possible once ledgers were damaged or lost as it frequently occurs.

The current process employed by the state agencies charged with administering motor vehicle documentation and registration has failed over the years to address the objectives of stakeholders effectively i.e. the federal and state authorities, and the vehicle owners and users in the country.

An organization's operation is always out by employing a particular system or method, which may be by use of machine or manual system of operation. During this process of manual operation, the applicant who requires that his (New Vehicle, fairly use or Brand-New Vehicle) should be registered, the motor licensing Authority (M.L.A) expects him to fill three copies of form B. He should also come with the necessary documents like custom duty certificate, bill of entry, bill of lading, custom payment schedule, import duty certificate, receipt authenticating the total amount paid to the former owner be it government or the vehicle dealer together with the host of other document. These documents are checked in order to make sure that they are bear custom stamp and signature and also complete. After he has gone through this, he now instruct the inspector officer in writing on the completed form for the applicant to go ahead with registration of his vehicle as well state the fees to be paid for the vehicle.

After the applicant has been charged the next person who is the inspection officer will now inspect the vehicle to know if the vehicle component numbers are

filled in the form like the chassis and engine numbers with what he has on his vehicle. After inspection, the officer will now forward the form to the sub-cashier, who collects the money, write a receipt specifying the amount paid and pass back the receipt to the motor licensing authority for signing.

All these process is tedious and subjected to loss of information. So, a new system is replacing the existing system cancel all the difficulties and problems involved in the vehicle registration process in Nigeria.

3.2 ETHEREUM BLOCKCHAIN SYSTEM

This system involves using the Ethereum blockchain network to store vehicle information in a decentralized and distributed database which is set up in departments involved in vehicle registration process. Each update of the vehicle data in one compartment will be read simultaneously in other compartments. This ensures consistent data availability across multiple departments and also addresses the problem of outdated data.

To further explain, let us consider the role involved in the vehicle registration process.

- **Registration Authorities/Admins**: The authorities responsible for approving and providing registration numbers, sending vehicles transfers and resetting vehicles. Registration authorities will register the vehicle after verifying vehicle details. All the details will be available to the authorities as

all entities are available under the same roof and making vehicle registration process more flexible rather than moving place to place. They will provide the registration number to the vehicle by interacting with the Dapp. This Transaction will be recorded in the Ethereum blockchain network. This would ultimately give identity to vehicle and all its details can be retrieved just by one system.

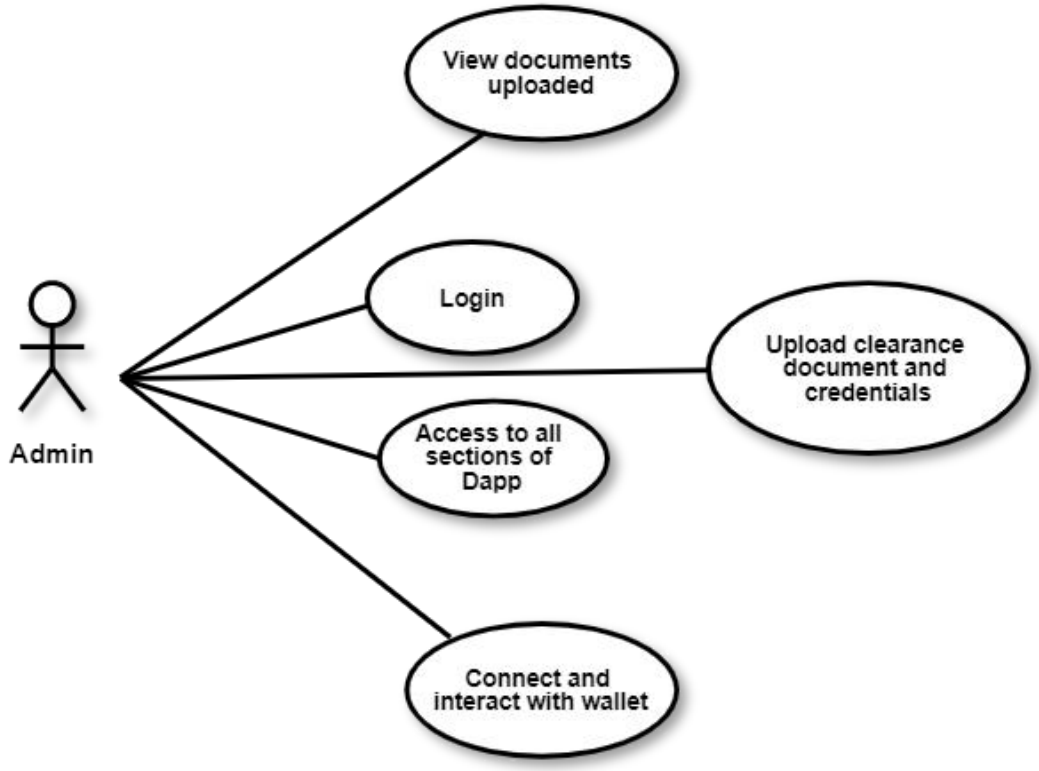

Fig 3.1: Illustration of Admin interaction with Dapp.

3.2.1 REGISTERING A NEW VEHICLE

Registering a vehicle implies creating a new registry, thus allowing user's requests to directly create entities in the system can lead to a system bloated with malformed asset registries. A registration process for a new vehicle in the car registration system is presented in Fig 3.2 below. A request is made through a front-office or an online portal and it is later processed by a national registry admin. The admin will verify the information available in the request and complete some of the information.

On a second step, the admin will verify that all request's information is according to the documents provided and might add new documentation before completing the process. As every information and documentation is correct and verified by a national registry admin, the request is fulfilled; a new vehicle is registered in the Ethereum blockchain network.

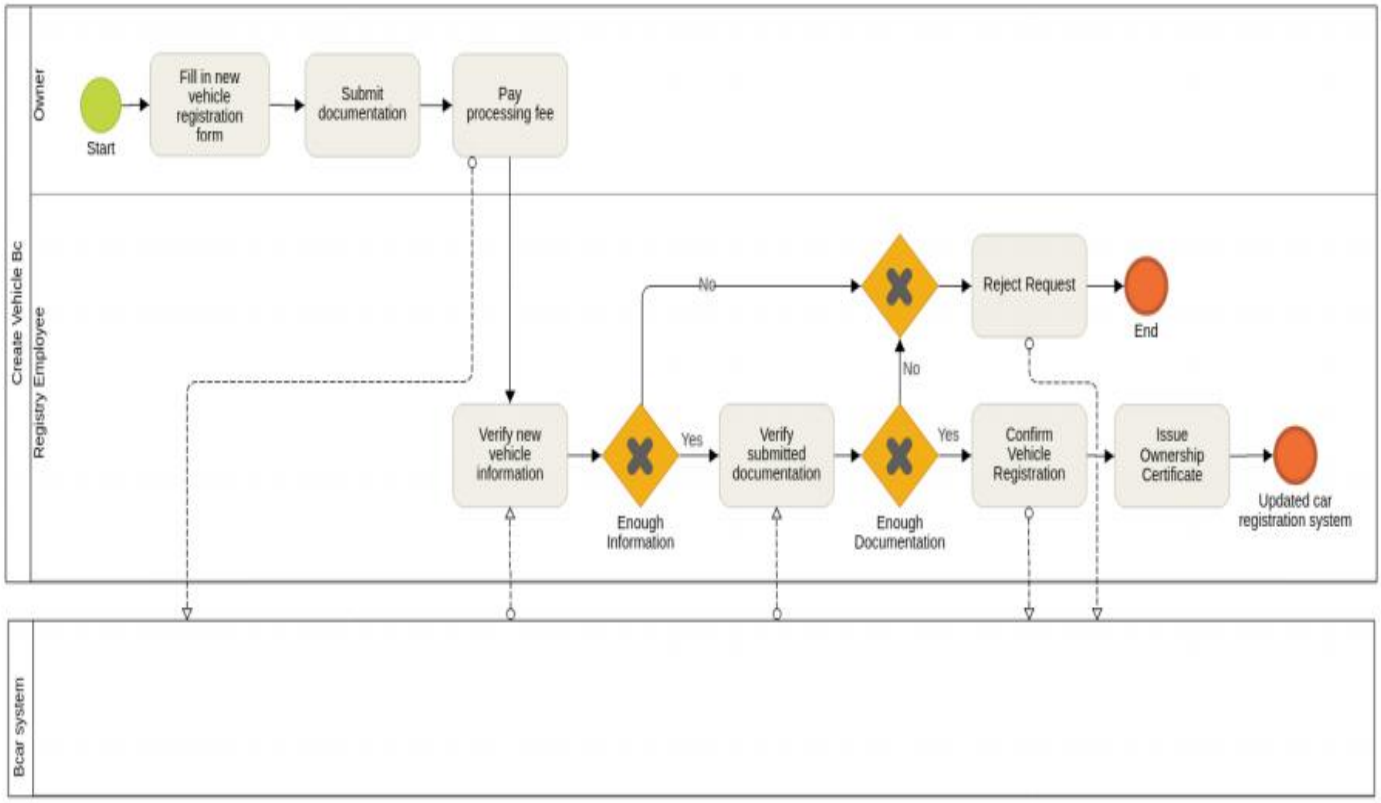

Fig 3.2: System for creating a vehicle in an Ethereum blockchain network.

Therefore when a vehicle is registered, the following information is required from the user: Letter of Attestation, Delivery note, Receipt of purchase or invoice, Proof of Ownership of the vehicle, and your identification papers.

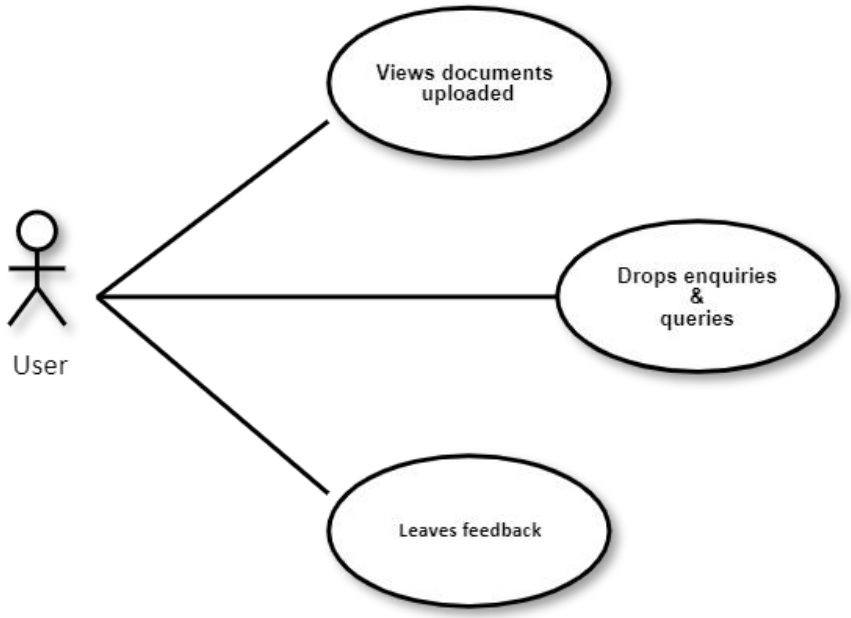

Fig 3.3: Interaction of the user with the Dapp.

The figure above shows the illustration of the activity the user performed whilst interacting with the decentralized app.

3.2.2 REQUEST FOR CHANGE OF OWNERSHIP

Regarding ownership change process we propose a two phase process. The current owner of a vehicle wishing to pass his ownership position to another entity is required to fill an online form with all the necessary information and documentation. Once this form is submitted, a pending ownership change is submitted to the Ethereum blockchain vehicle registration network, as modeled in Figure 3.4, which is later confirmed by the prospect owner.

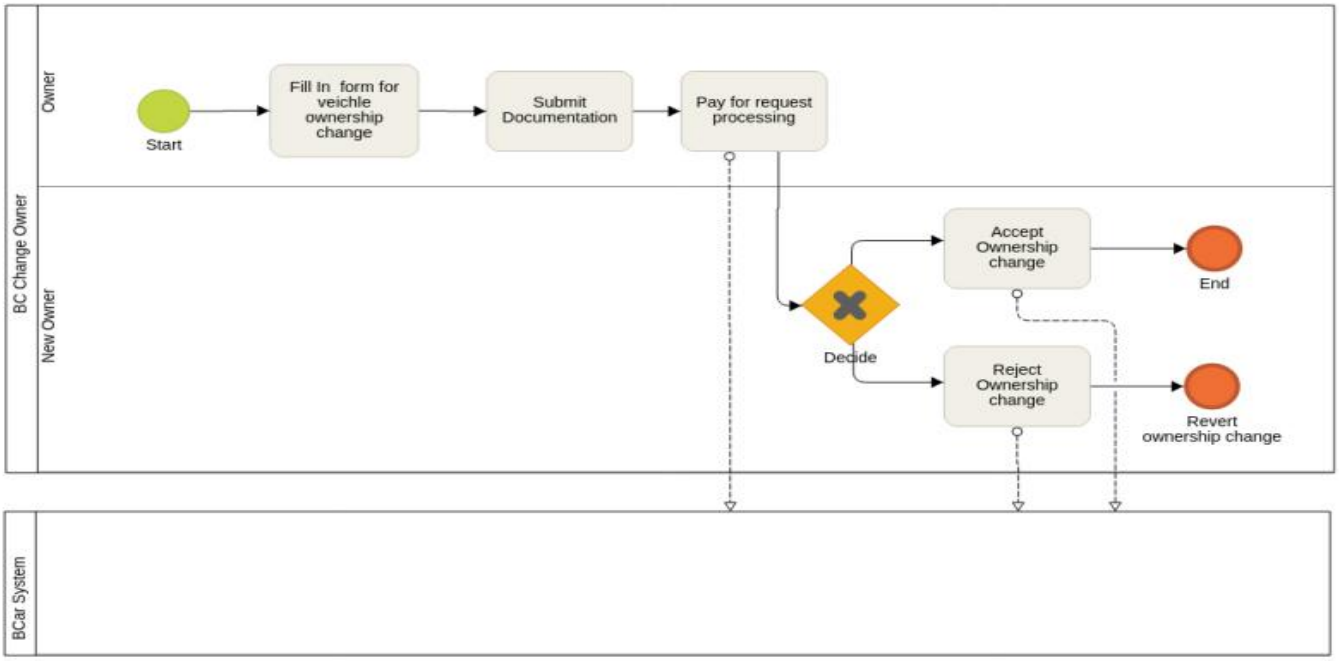

Fig 3.4: System process for changing ownership details in an Ethereum blockchain network.

This step requires the admin to collect details of the owner to issue a Change Owner transaction, specifying the VIN, the registration number and the make of the vehicle, as well as the list of the new owners to which the current owner will give his share of the vehicle and the share percentage that he wants to transfer to the new owners.

As the first step is concluded, the vehicle ownership changes to the new owner. However the new ownership is still required to be approved by the new

owner. This state is represented in Figure 5 as Waiting Ownership Change state. In order to complete the ownership change, only the new owner registered in the initial Change Owner transaction is able to confirm this operation issuing a Confirm Ownership transaction specifying the vehicle's VIN, the registration number, the make, and the ownership share. Only after this step the ownership information is considered valid, regarding judicial obligations and the new owner is considered legitimate owner.

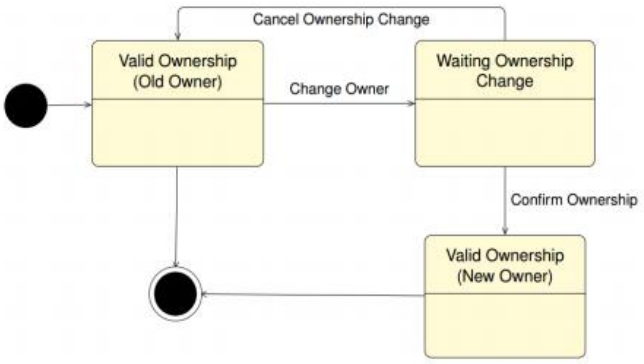

Fig 3.5: Change Ownership transaction flow.

The Ethereum blockcahin system can replace the existing system by interacting with the Dapp because of its efficiency, transparency, record security and immutability.

In the next section, the tools, techniques, and approaches taken to ensure the design and development of the system will be considered.

3.3 SYSTEM DESIGN

In developing and deploying the decentralized app (Dapp), the following tools were used;

S/N	TOOLS	USE
1	React	Utilized for building the structure of the web pages
2	SCSS	Styles the appearance of the website
3	Bootstrap	Create responsive web pages.
4	Remix	Blockchain IDE
5	Solidity	Programming language for building and writing smart contracts
6	Visual Studio code	Integrated development environment for client side
7	IPFS	Blockchain protocol for large data
8	Metamask	Crypto wallet
9	Georli Testnet Network	To get test Ether (Goerli ETH) to execute transactions
10	Web3 JS	Javascript library to interact with the blockchain

Table 3.1: Implemented tools and materials.

React: It is a declarative, efficient, and flexible JavaScript library for building user interface. React was chosen over others because it offers interactivity to the layout

of any user interface, it also allows fast, high-quality and scalable application development that saves time in developing the Dapp.

SCSS: SCSS is an acronym for Sassy Cascading Style Sheets. It is basically a more advanced end evolved variant of the CSS language. It was chosen over others because it contains fewer codes so one can write CSS quicker. It has a very good documentation and it provides nesting so one can use the nested syntax.

Bootstrap: The responsiveness of the web pages was handled by Bootstrap, which was chosen because of its open source nature, extensive, well-organized documentation, and quick learning curve. Additionally, it provided basic features like color, border, margin, padding, etc. that were simple to modify to suit the project's requirements.

Remix: An integrated Development Environment, a no-setup tool with a graphic user interface for developing smart contracts. Its flexibility and intuitive user interface provided the leverage for developing, debugging, deploying, and testing Ethereum and EVM-compactible smart contracts.

Solidity: a high-level programming language created specifically for creating, designing, and executing smart contracts. As the primary programming language developed by the Ethereum Network Team expressly for the blockchain platform (Decentralized app), it was chosen for use in creating the smart contracts for the Dapp because of its extensive documentation and ease of use.

Visual Studio Code: it is a code editor redefined and optimized for building and debugging modern web and cloud applications. Its ability to enable instant productivity with syntax highlighting, bracket matching, auto identification, box-selection, snippets and many more with support for hundreds of languages makes it a preferable choice in developing the Dapp.

IPFS: InterPlanetry File System is a protocol, hypermedia and file sharing peer-to-peer network for storing and sharing data in a distributed file system. It combines multiple blocks commonly used to build distributed applications into a distributed storage system and was designed to work in conjunction with the blockchain.

Metamask: a cryptocurrency wallet that lets users store and trade coins, engage with the Ethereum blockchain ecosystem, and host an expanding number of decentralized applications (dApps). Because of its easy interaction with its extension tool, which enables a developer to verify a DAPP's operation and permits users to execute transactions through the browser, this cryptocurrency wallet was selected over others. Additionally, it stores account data on several networks, including testnets and mainnets.

Georli Testnet Network: Before deploying on Mainnet, the primary Ethereum network blockchain development can be tested on this test network for Ethereum. Before the built decentralized application was deployed in the Mainnet, it was used to make sure that all of the requirements were met. It is important to use Georli

Tesnet because deploying to the Mainnet would be too expensive. However, the Mainnet duplicates every action and procedure taken on the Testnet.

Web3 JS: is a JavaScript library that was chosen because it enables interaction between programmers with a remote or local Ethereum node, which may be used to create websites or software applications that interface with the blockchain.

3.4 SOFTWARE DEVELOPMENT LIFE CYCLE.

The SDLC approach chosen for developing the decentralized application is incremental development, which is based on the idea of generating a basic implementation, making it available for user feedback, and then iterating through much iteration until a functional system is established. Because it was less expensive and easier to make modifications to the software as it was being developed by constructing the decentralized application incrementally, this technique was chosen above others. Every version of the software that was made available includes some of the features required to complete the decentralized application. Additionally, compared to previous approaches, such the water fall model, much less study and documentation was required. This allowed time and resources to be focused on more difficult and labor-intensive areas of the project.

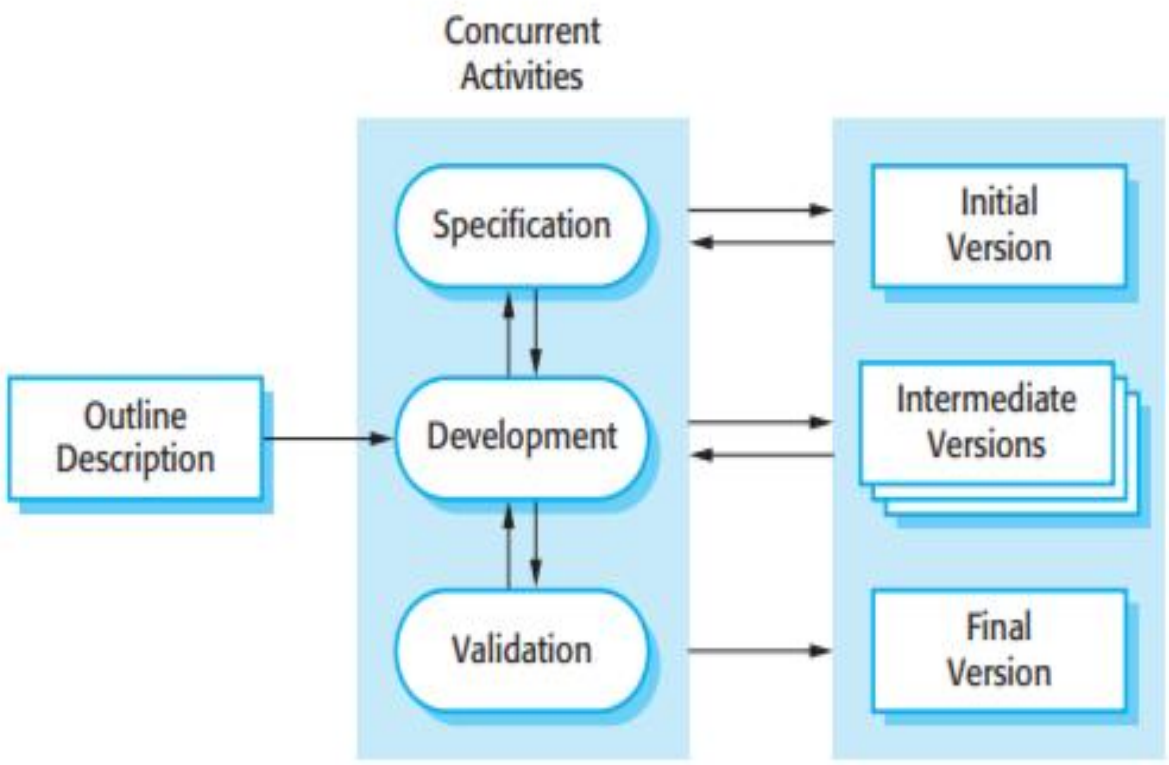

Fig 3.6: Incremental development model.

The system's initial iterations often featured the features that were most urgently needed which required developing the web3 JS bridge between the smart contract and the client side. An initial version was released once this connection was made. More features were then added to the initial version following the completion of the reevaluation. These included adding a system for admin authentication, putting the sending and receiving of data protocol into place, incorporating metamask into the decentralized program, and revamping the client side to make it seem better. The decentralized application's final version was then implemented along with some significant changes resulting from the installation of the IPFS protocol as

well as last-minute updates to other areas that had been pushed out in earlier iterations.

In the following chapter, the results obtained from the deployment of the final version will be reviewed in detail, including what each element of the program is designed to do and what happens once that particular activity has been carried out.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter contains the results and discussion of the implementation of the project using the mentioned technology outlined in preceding chapters.

4.1 IMPLEMENTED RESULT

The system goal is to build a decentralized application that can be used in vehicle registration process in Nigeria using the Ethereum blockchain. The implementation of the system is presented below:

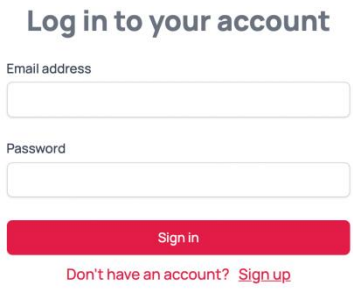

Fig 4.1: Admin login page

This displays the created admin login page that filters out whether or not personnel are permitted. The prior admin might change, necessitating a password change, of which they would no longer be able to access the Dapp and do any tasks that had been assigned to them.

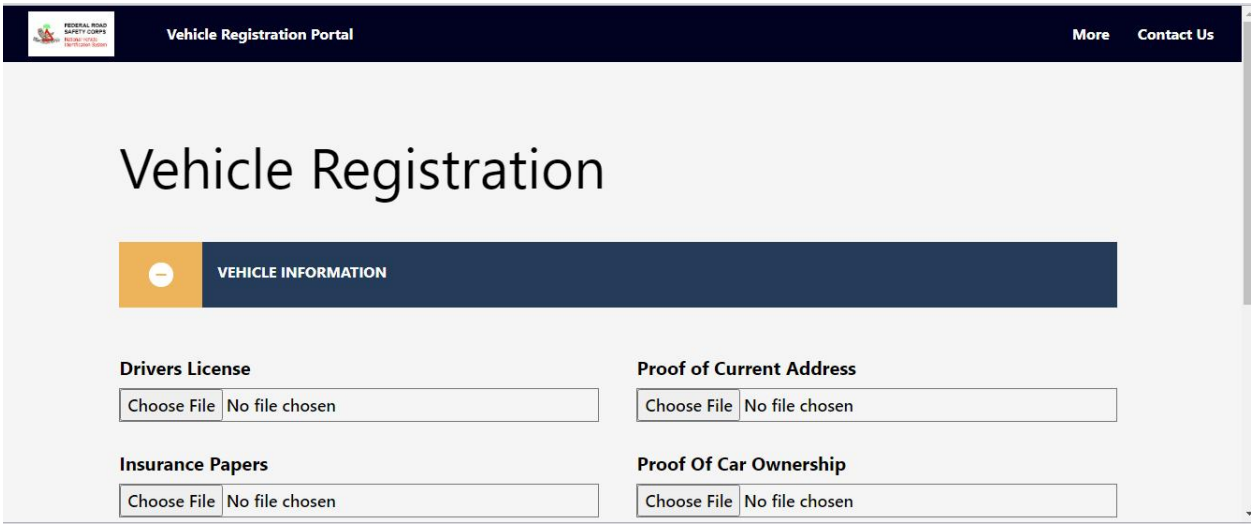

Fig 4.2: This shows the create info page.

The portion of the decentralized application where data will be uploaded to the blockchain is displayed on this page. Data will be sent directly to the blockchainfrom people who register their vehicles.

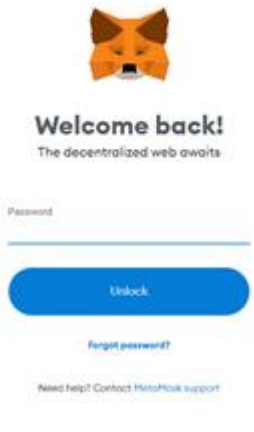

Fig 4.3: Metamask sign-in pop up.

For data to be sent to the Ethereum blockchain by the Admin in Fig 4.2, metamask wallet must be connected and authorized.

Fig 4.4: Successful signing in of Metamask.

This section of the Dapp shows the successful signing in of the metamask. After this has been accomplished then data can go through to the Ethereum blockchain.

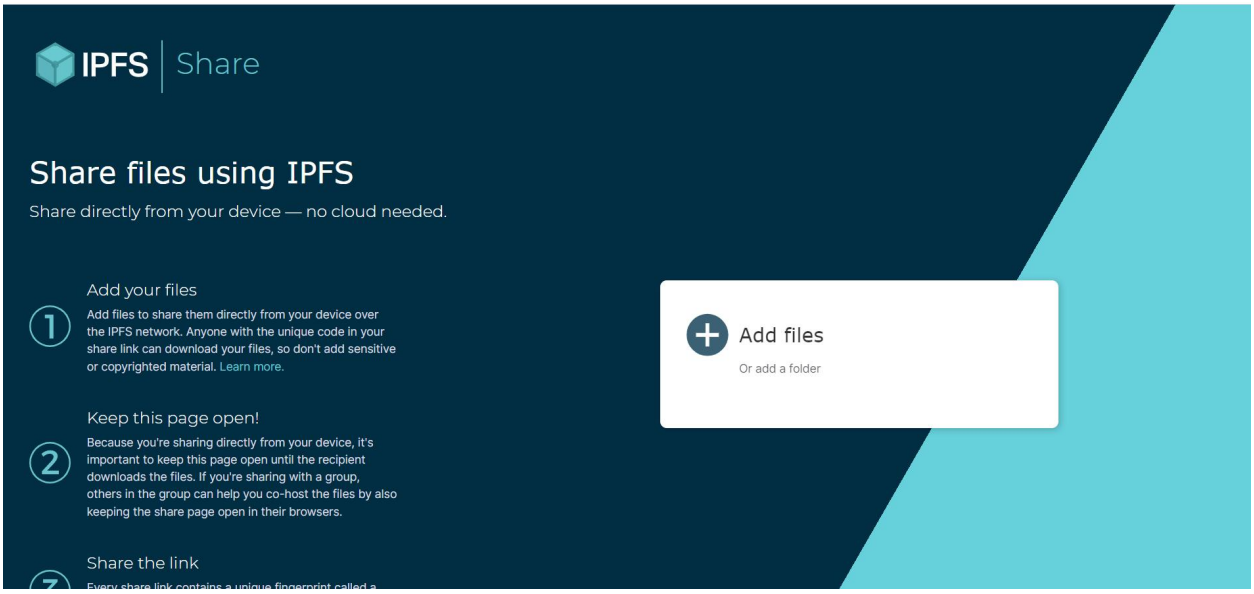

Fig 4.5: The IPFS page to upload document.

The retrieved link or QR code received after the documents has successfully been uploaded to IPFS is then given to the personnel who registered vehicle, which in turn can also share with which ever third party that may require these documents to view or perhaps download at a later time.

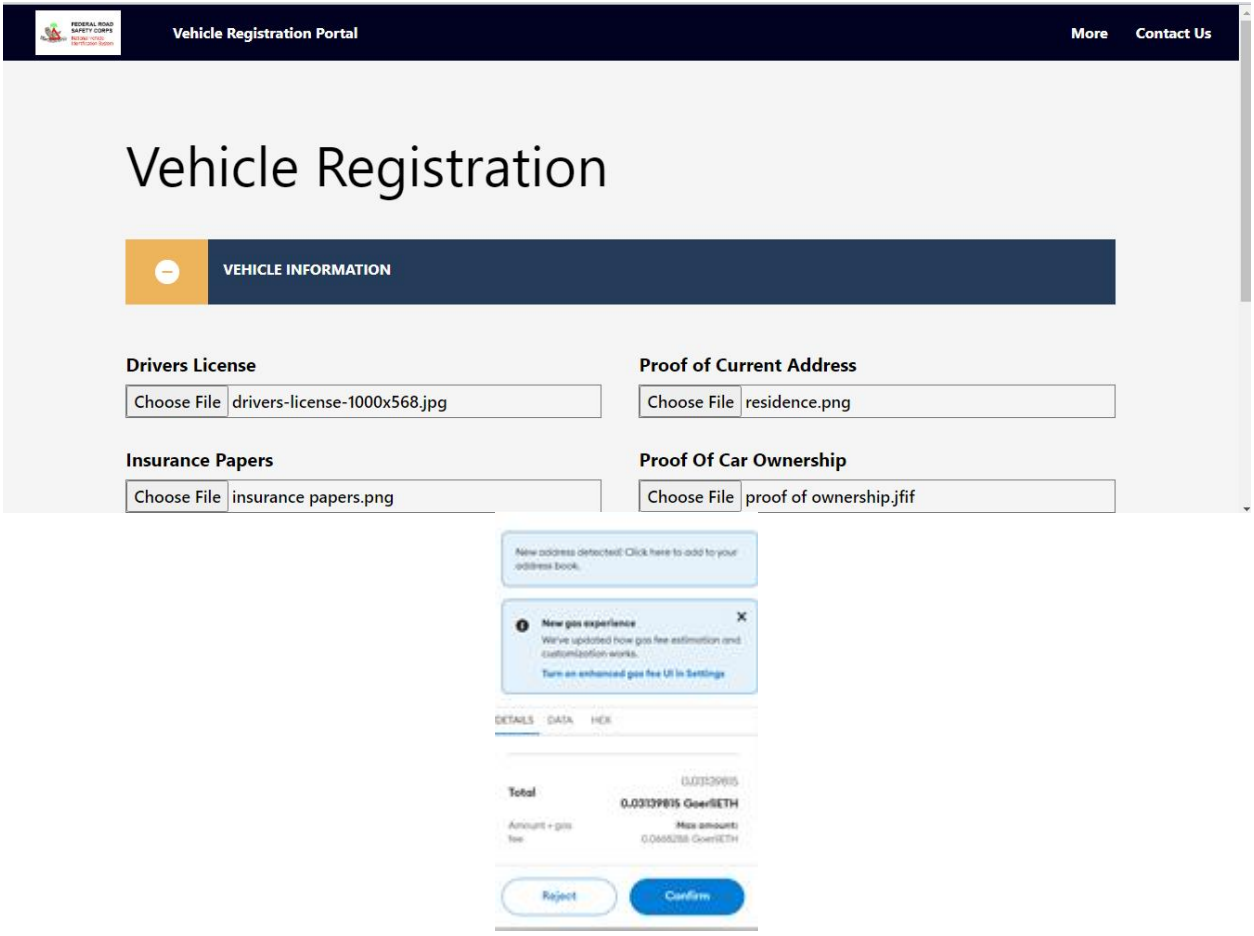

Fig 4.6: Data about to be uploaded to the Ethereum blockchain.

With the document uploaded, and the link retrieved with information correctly filled then, it is submitted. Then the approval message is prompted and immediately it is confirmed the transaction starts processing.

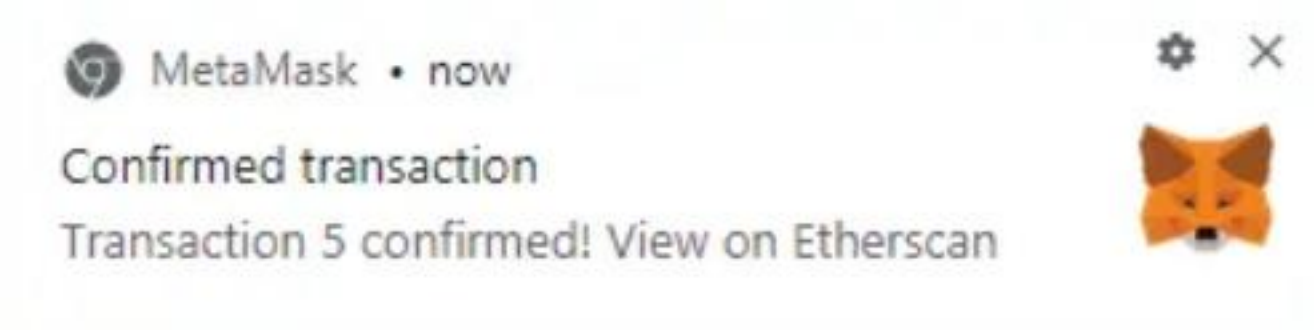

Fig 4.7: Notification of confirmed transaction.

After completing that, we can now use the get info page to subsequently obtain our information from the blockchain.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This study is concluded by stating that the Ethereum blockchain network and its applications will be in use for as long as the features offered, such as privacy, security, and traceability and so on is worthwhile. Thus, it is advantageous to act as the cornerstone of system reliability.

Finally, the system will become more dependable and effective when vehicles in Nigeria are registered utilizing the Ethereum blockchain network.

5.2 RECOMMENDATION

The Ethereum blockchain network has been embraced and applied in a variety of settings in developed countries, taking into account the global growth of technology. I would strongly urge Nigeria's government to include this into their system, not just for vehicle registration but also for any other use cases where blockchain technology will be beneficial. Because of the beneficial effects this will have on the Nigerian system and economy.

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APPENDIX

```
import React, { useState } from "react"
import "./Navbar.scss"
import { AiOutlineMenu } from "react-icons/ai"
import { GiCancel } from 'react-icons/gi'

import logo from "../../assets/logo.jpg"

const Navbar = () => {
    const handleClick = () => {
        setIsOpen(!isOpen)
    }
    const [isOpen, setIsOpen] =
useState(false)

    return (
        <div >
            <div className="Navbar">
                <div className="left__nav">

                    <img className="h-full
w-3/12 rounded-2xl p-4" src={logo} />
                    <p className="navbar__name
w-9/12">Vehicle Registration Portal</p>
                </div>
                <div className="right__nav">
                    <AiOutlineMenu onClick={()
=> setIsOpen(!isOpen)} className="text-white
navbar__menubar md:hidden" />

                    <a
className="navbar__links nav-h" >
                        More
                    </a>

                    <a
className="navbar__links nav-h" >
                        Contact Us
                    </a>

                </div>
            </div>
```

```
                </div>
            </div>

            {isOpen && (

                <div className="sidebar-con
md:hidden" >

                    <nav class="sidebar" >
                        <div className="flex
justify-end">
                            <GiCancel
onClick={() => setIsOpen(false)}
className="text-black text-3xl pt-2 mx-2" />
                        </div>

                        <div className="w-full
flex justify-center">
                            <img
className="w-6/12" src={logo} />
                        </div>

                        <ul className="flex
flex-col gap-5 mt-10">
                            <a className="flex
px-4 text-xl justify-between text-white font-
semibold" onClick={handleClick} to="/">
                                More

                            </a>
                            <a className="flex
px-4 text-xl justify-between text-white font-
semibold" onClick={handleClick} to="/login">
                                Contact

                            </a>
```

```
                                </a>


                            </ul>
                        </nav>
                        <div className="side-
overlay" onClick={() => setIsOpen(false)}></
div>
                    </div>
                )}

            </div>
        )
}

export default Navbar
```