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Land Administration and Registration using Blockchain Technology

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Abstract: ***Land organization and title enlistment framework is the framework for putting away land title data and overseeing exchanges including area titles. Because of the affectability of land issues, land organization and title enlistment framework ought to be solid to stay away from any report falsification, accessible constantly, and set aside a short effort to finish undertakings. Along these, this examination targets planning a model for such framework dependent on blockchain innovation. The proposed model incorporates the Land Database Management System (ILMIS) with Blockchain which empowers encryption of data from LDMS to get the data of each land title and store it to the blockchains. The model further scrambles the land data from LDMS when required and afterward contrast it and people customer's information from blockchains for verification. Furthermore, the general public is relied upon to profit by this examination as the time and cost for enrolling area title will diminish and the conceivable outcomes of a land parcel having more than one proprietor won't be there.***
Keywords: Blockchain and LDMS.

I. INTRODUCTION

The advanced guide of the twenty first century is always advancing as data and correspondence innovations (ICT) have turned into an indivisible piece of each part of contemporary networks. Simple, straightforward, responsible, secure and successful connection among natives and governments has been a pattern of the most recent decades. In this way, governments continue endeavouring to consent to the prerequisites of natives through conveying the state benefits in the best and productive manners conceivable. Headways of the ICT vigorously impact the presentation of the present governments and in numerous perspectives decide the course of activities of nations' advancements. In such manner, electronic government is probably the boldest accomplishment of the decade. Electronic governments make stages for arrangement quick, straightforward, modest and helpful answers for resident related concerns. Contemporary advances are always developing and testing the social orders. Computerized reasoning, blockchain, shrewd agreements, electronic ID's and numerous different progressions are effectively being incorporated in everyday connections of governments and natives. With the development of the data and correspondence innovations state specialists have been tested to give increasingly productive and successful administrations to the natives, yet ensuring significant level of information security, straightforwardness, auditability and protection.

As a probably the greatest accomplishment of the advanced data society blockchain innovation can be regarded a troublesome development with the possibility to reform the way society, including governments and non-benefit and revenue driven associations to deal with themselves and speak with the partners. Innovation makes a stage for the circulated administration and results in each part of partners' connections through influencing entire scope of record preparing, information stockpiling, data trade, control appropriation, straightforwardness and other urgent perspectives the current business forms. In such manner, blockchain innovation makes an enormous open door for governments to prevail in every one of the parts of government-native connections and to offer the most progressive administrations inside electronic stages. Blockchain is an electronic record of advanced records, occasions, or exchanges that are hashed cryptographically, confirmed, and controlled through a circulated or shared system of members utilizing a gathering accord convention. The blockchain is circulated among a huge number of PCs with components for approving exchanges that use a gathering agreement convention.

Blockchain innovation is the method for looking contrastingly the inward elements of the ordinary database which enables to a solitary position like managers who can change the data in the database on the off chance that they need to. This power can be manhandled by unfaithful heads. Typical database endures the issue of single purpose of disappointment and causes them to depend much on reinforcements if there should be an occurrence of disappointment and when both running database and reinforcements are hurt can bring intense issue. Research discoveries show that the blockchain works contrastingly contrasted with typical database whereby the data is encoded and put away in each hub associated with the system and take out the probability of having single purpose of disappointment, misrepresentation, and defilement.

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A. Problem Statement

Land administration alludes to a framework whereby possession and land-related rights are recorded by an administration element. These records give proof of title, encourage exchanges, and avoid extortion. The Securing land property rights are a key challenge in advancing economic improvement. Then again, land records are ordinarily kept on paper in an centralized area. This paper-based framework isn't just lumbering to get to and keep up yet in addition powerless against natural or man-made catastrophes. This challenge is taken as “land administration in the view of Blockchain”.

B. Objectives

The proposed blockchain-based land vault would have the accompanying primary objectives:

1) To make faster usage of a pending proprietorship exchange in the land register.
2) To make automated warnings of proprietorship changes or changes in the land register and cadastre.
3) To do greater straightforwardness of exchanges for clients around the difference in possession in the land register and cadastre.
4) Allowing advanced documents for agreements and records among partners.
5) To provide more adaptability and robustness.
6) To provide greater security for land vault entertainers through more straightforwardness.

C. Existing System

Currently, the land registration process is done through a Certificate of Customary Right of Occupancy (CCRO) for village land, and Ministry of Lands, Housing, and Human Settlement Development for urban land or reserved land. This process has got some challenges, like taking too long to complete, corrupt government officials, registrars of titles and village council or registering several owners to the same land title, etc.

D. Proposed System

Blockchain technology is the way of looking differently the inner functions of the normal database which gives the power to a single authority like administrators who have the ability to change the information in the database if they want to. This power can be abused by unfaithful administrators. Normal database suffers the problem of single point of failure and makes them depend much on backups in case of failure and when both running database and backups are harmed can bring very serious problem.

II. LITERATURE REVIEW

In 2018, J. Michael Graglia, Christopher Mellon give a diagram of the ways that blockchain is as of now being utilized for land also, land vaults, and a feeling of how its utilization may change later on. After a foreword watching bigger patterns with respect to the job of blockchain in the development for an open and decentralized web, the presentation puts forth a wide defines with respect to why blockchain bodes well for land.

In 2016, Anand, A., Mckibbin, M., & Pichel briefly explains Blockchain innovation is a disseminated database keeping up a permanent open record everything being equal. This innovation is troublesome in light of the fact that it takes into account the time stepped bookkeeping of exchanges between any gatherings that uses this as a strategy for recording data. Governments, organizations, and people can know for certain the data recorded has not been modified without a record of the change happening. Decentralized stockpiling of data is finished by each hub on the system, each keeping up and consistently confirming a total duplicate all things considered. To make a record on the blockchain clients submit novel numerical marks with secretly held PC keys which further serves to limits misrepresentation by guaranteeing confirmation of the client. Multi-signature administration records take into consideration expanded security by appropriating exchange endorsement over key leaders engaged with the records.

In 2016, Donegan, S. L. give report on Risks of Blockchain Technologies. Blockchain-based applications, for example, Bitcoin or Ethereal are raising advancements, however a sensational increment in mechanical and scholarly intrigue in the innovation is obvious. New companies and enormous money related players are working seriously on blockchain-based applications, making this one of the most encouraging drivers of money related innovation. They connected cryptographic monetary frameworks to effectively settled research streams around trust-related issues in instalment frameworks and advanced monetary forms, and computerized resource the executives.

In 2015, Peters, G. W., & Panayi, E. give an outline of the idea of blockchain innovation and its potential to disturb the universe of banking through encouraging worldwide cash settlement, shrewd contracts, robotized banking records and computerized resources.

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In such manner, they rst give a brief diagram of the center parts of this innovation, just as the second-age contract-based advancements. From that point they talk about key issues that must be considered in growing such record based advancements in a financial setting.

In 2014 and 2015, Snow, P., Deery, B., Kirby, P., Johnston, D., Stradling, A., Sprague, S. Schneider depict how Factom makes a conveyed, self-sufficient convention to cost successfully independent the Bitcoin blockchain from the Bitcoin cryptographic money. They examine customer characterized Chains of Entries, customer side approval of Entries, a conveyed accord calculation for recording Entries, and a blockchain tying down approach for security.

In 2013, Silayo, E. proposes tends to the job that experts can play to add to the detailing and usage of National Land Policies. Basic land part gives that the strategies address are inspected, learning based characteristics that ought to describe experts are talked about, and choices for the path forward are proposed. In the process coming up next are tended to: imaginative methodologies, systems administration, organizations and collaboration.

In 2013, Felician Komu dwells on the availability of the old set up valuation schools inside the Eastern Africa locale to grasp the developing requirements for a mixture order of land organization. They watches awesome improvements that include occurred inside the land organization segment and advance contentions towards solidifying these contending a case for colleges to devise scholastic training that clears route for the development and extension of land organization which should be viewed as a widely inclusive.

In 2010, Kombe, W. clarifies the hazardous of land procurement for open use in Tanzania. Three cases are inspected to investigate how social, institutional and monetary procedures and premiums also, the related key players interface to produce clashes, and the fruitless endeavours made to resolve them.

III.SYSTEM DESIGN

System design thought as the application of theory of the systems for the development of the project. System design defines the architecture, data flow, use case, class, sequence and activity diagrams of the project development.

A. Design Architecture of the model

The architecture of the proposed model is seen with integrated components. The components are land database system and Etherium Blockchain, and the model itself. Land database management systems component is how the model communicates with the land system. Land database system receives credentials entered by the user from the model for validation and verification purposes. Moreover, land database receives from the model the information entered by the user about a certain transaction or a land title. Land database system responds to the request from the model with the status of the user, the information requested by the user about a certain transaction or a land title. The model component executes all the commands which requested by the user including encrypting the information from land database and then compare it with the information stored in blockchains for verification purposes. The model component presents the validation and verification report to the user which also includes performing notarization process for the issuance of land titles and certificates.

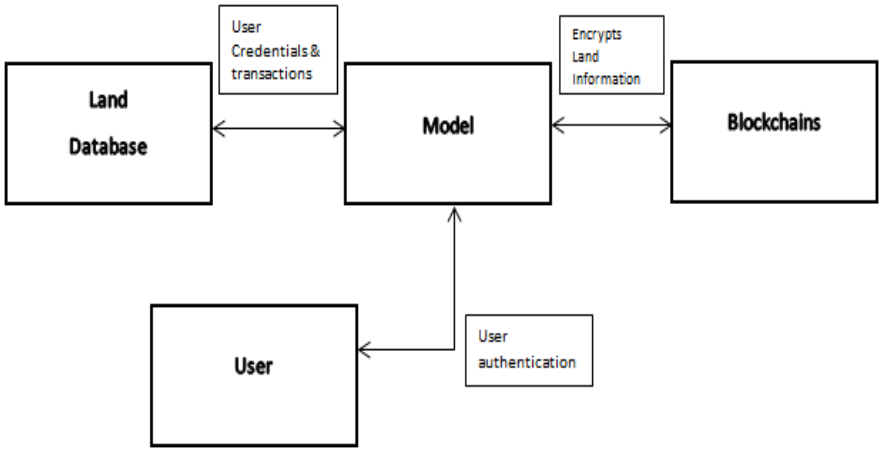

Fig.1 Block diagram of the model for land registration and administration

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Taking a look at Figure 2, the modules in the System are

1) Land Details Signing

2) Land Details Verification

In order to digitally sign the land assets, the Land Owner has to enter the details such as property id, owner name, address of land and user identification number, the land signing module will take the details and will convert it to a fixed value called as hash, then the hash value will be encrypted with the private key generated by the land owner using cryptography algorithms, the encrypted hash value will be the digital signature, the digital signature along with the property id of land will be kept in the Blockchain, it can be retrieved for the verification process. For the verification of land assets, the officials or users has to enter the public key generated by the land owner and all the details required for the land and land owner into the verification module, a hash value(h) will be generated with details entered by the officials, the verification module will take digital signature of land from the blockchain with the help of property id entered by the officials, then decrypt the digital signature with the public key which will be in the module , will be having the hash(h1) after decryption of digital sing. After all, the module will compare the hash values h and h1 to tell whether the land details entered are valid.

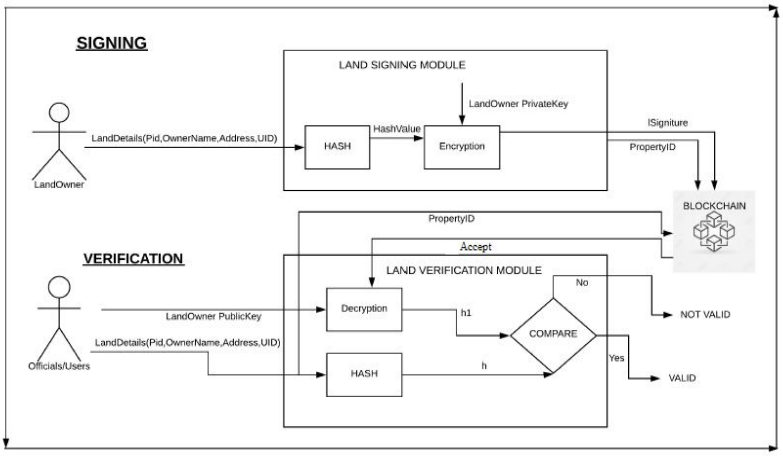

Fig. 2 Architecture of the model for land registration and administration

B. Use case Diagram

Use case diagrams show the interaction between the outside worlds and the model. The diagram describes a sequence of actions or the system behaviour that provide something of measurable value to an actor. Also, use case diagrams help to understand system requirements in depth. The use case diagram in Figure 5.3 shows the interaction between the user, model, land database system, and the blockchains. The user verifies land title information and able to get land titles histories from the model. Etherium blockchains receive details of the land titles information from the model.

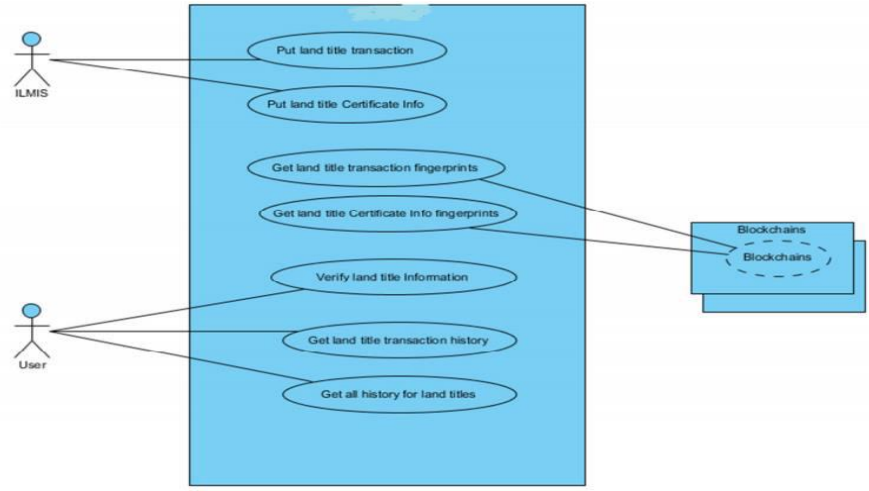

Fig. 3 Use case diagram showing interaction in the model

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C. Sequence Diagram

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Figure 5.4 shows an example of how the user is interacting with the model. A user starts accessing the model by entering his/her credentials, which are then forwarded to the land database for verification. Land database system responds with status on whether user credentials are accepted or not. If the user credentials are accepted, the user will be requested to perform his/her action. The action illustrated in Figure 5.4 is to verify land title information. The information entered by the user is checked to the land database if the information is not in land database he then prompted the information is not found. If the information is found, the information will then be encrypted and compared with the fingerprints information from blockchains. Lastly, the user has prompted whether the land title information is valid or not.

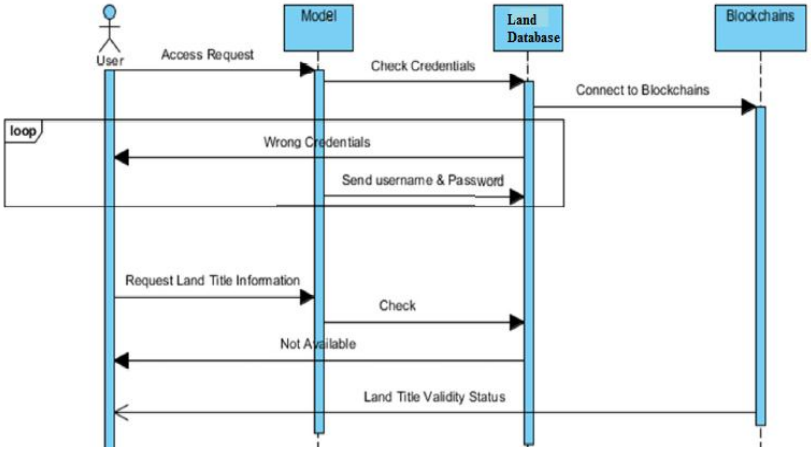

Fig .4 Sequence diagram for the model

IV. IMPLEMENTATION

A. Dependencies

Dependencies to develop my rest decentralized application are:

1) Notepad(I prefer Visual studio code)
2) Chrome(a browser)
3) Remix IDE: Browser based or online IDE to get instant feedback for solidity code.
4) Ganache: It provides a local server with 10 di errant addresses con-training 100 ether per each.

We pay the miners with something called Gas, which is the cost to run a contract. When you publish a smart contract, or execute a function of a smart contract, or transfer money to another account, you pay some ether that gets converted into gas.

B. Wallet

Wallets are very important part of a smart contract. It serves 2 purposes:

1) It serves as client to Etherium wallet. To make a transaction on network ether has to be spent and you can authorize these payments using this.
2) To communicate with a Blockchain and to deploy, you need to either have a full node or a wallet client of the network. A wallet can facilitate the communication with the network.

C. Deployment

The contracts are written in solidity codes and these are to be compiled to get the Application Binary Interface (ABI) codes. ABI is the interface be-tween two program modules, one of which is often at the level of machine code.

To deploy a contract the following steps are to be taken:

1) Compile the code and get necessary ABI code.
2) Make a deployment with a wallet address as transaction sender.
3) Authenticate the transaction form the wallet and pay the transaction cost.
4) Your contract will be deployed and will be assigned a public address which can be used to access it.

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D. Web Interface

A web app can be used to work with the contract. A backend JavaScript framework, web3.js, can interact with the blockchain. It can connect to the network, identify the contract and perform transactions. The web3js framework works as it Connect to a network using 'web3Provider' to a local host (local test net) or a global network and Create a contract instance using the ABI code and Contract address. Contract address identifies the particular contract on the network to interact with and the ABI code specifies how to access each function.

V. TESTING

A. Overview

The model was tested for verification using statistical usage model (Markov chain). Markov chain is a widely recognized approach to guarantee the correctness of a system by checking that any of its behaviour is a model for a given property. The statistical usage model is simple to implement, understand and use by all people who are not pure researchers.

B. Testing of the Model

Figure 5 below shows the process of testing the model using state diagram. It indicates 7 steps which were followed by the model for verifying land title information and transactions. Before the testing process, the study assumes that the records have already been stored in both LDMS and in Etherium Blockchain. Figure 5 below shows the test case model.

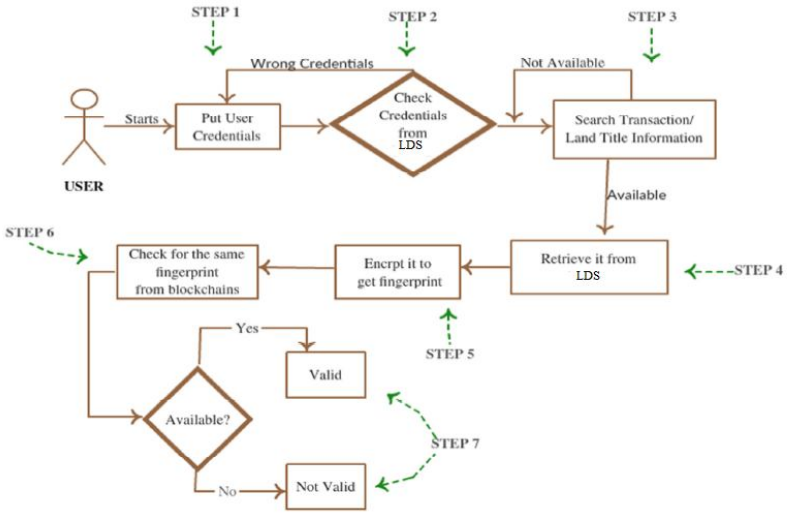

Fig. 5 Model testing for verification

1) In step 1**,** the user starts by putting his credentials, and then is allowed to continue with step 2.
2) In step 2**,** user credentials are checked in land database system for validation. Wrong user credentials force the user to return to step 1, on other hand right credentials allow the user to continue to step 3.
3) In step 3, the user searches for land titles information or land titles transactions. If the information searched is not available, the user is prompted to check the spelling correctly and try again. Availability of information means that the system goes to the step 4.
4) In step 4**,** user retrieves the information from LDMS.
5) In step 5, the model encrypts the information from the land database to get the fingerprints.
6) In step 6**,** the model searches the fingerprints from the Blockchain.
7) In step 7**,** the model compares encrypted fingerprints obtained in step 5 with the fingerprints from blockchains obtained in step 6. If the encrypted information from step 5 is also found in block chains from step 6 means that the information is valid, otherwise, means the information is not valid.

The results of the model are summarized in Table 1 below. The results are divided into seven states. The first state from step 1 to step 2, the transitional stimuli was the user to insert to the model his credentials the probability of success was 1 (100%). The second state from step 2 to step 3, the transitional stimuli was to check for the entered credentials from land database with a probability of success of 0.5 (50%).

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Another probability of 0.5 was for the wrong credentials entered. The third state from step 3 to step 4, the transitional stimuli was to search for transaction or land title information with a probability of success of 0.5 (50%). The probability of failing may be caused by wrong credentials entered or bad connection. The fourth state from step 4 to step 5, the transitional stimuli was to retrieve the information from land database with a probability of success of 1. The fifth state from step 5 to step 6, the transitional stimuli was to encrypt the information from land database to get the fingerprints with the probability of success of 1. The sixth state from step 6 to step 7, the transitional stimuli was to check for the same fingerprints from the Blockchain with a probability of success of 1. Final state from step 7 to the final step, the transitional stimuli was to check for the comparison between the encrypted information from the land database and the fingerprints from the Blockchain. The similarities between them mean that the information is valid, otherwise, the information is not valid. The state had the probability of success of 0.5 for valid information and probability of success of 0.5 for non-valid information.

Table. 1 Testing Results of the Model

State	Transitional Stimuli	Output	Probability	Expected Percentage
Step 1 – Step 2	Inserting user credentials	Succeed	1	100%
Step 2 – Step 3	Checking credentials from LDMS	Wrong credential	$\frac{1}{2}$	50%
		Succeed	$\frac{1}{2}$	50%
Step 3 – Step 4	Searching for transactions or land title information	Available	$\frac{1}{2}$	50%
		Not Available	$\frac{1}{2}$	50%
Step 4 – Step 5	Retrieving information from LDMS	Succeed	1	100%
Step 5 – Step 6	Encrypting information from LDMS to get fingerprint	Succeed	1	100%
Step 6 – Step 7	Checking for the same fingerprint from blockchains	Succeed	1	100%
Step 7 – Final	Checking for the validity of the information	Not Valid	$\frac{1}{2}$	50%
		Valid	$\frac{1}{2}$	50%

VI. RESULTS AND SCREENSHOTS

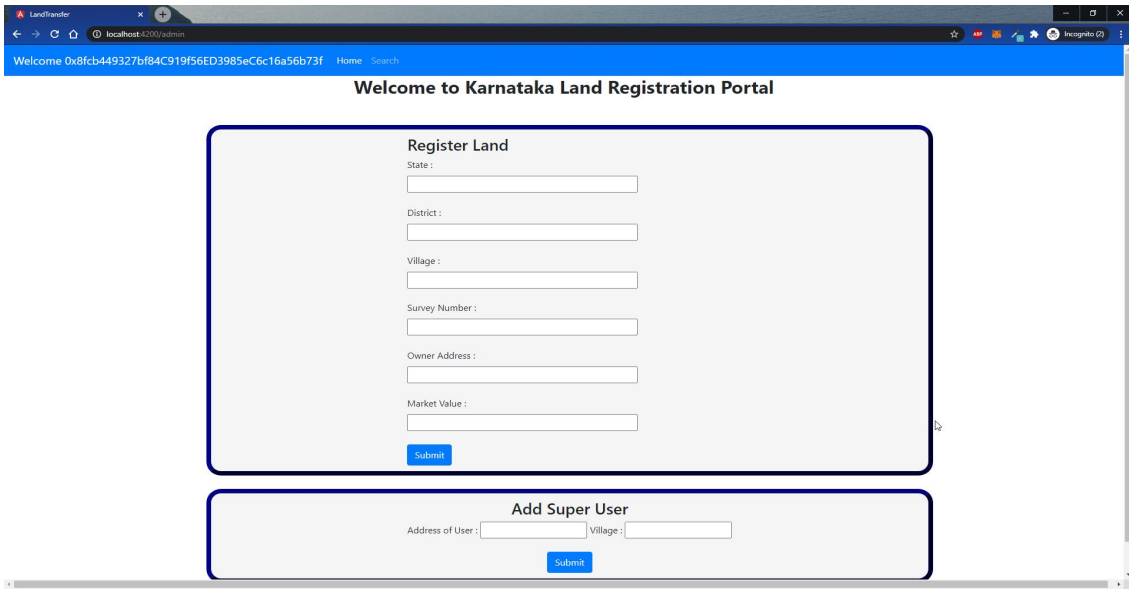

Fig. 6 Admin panel

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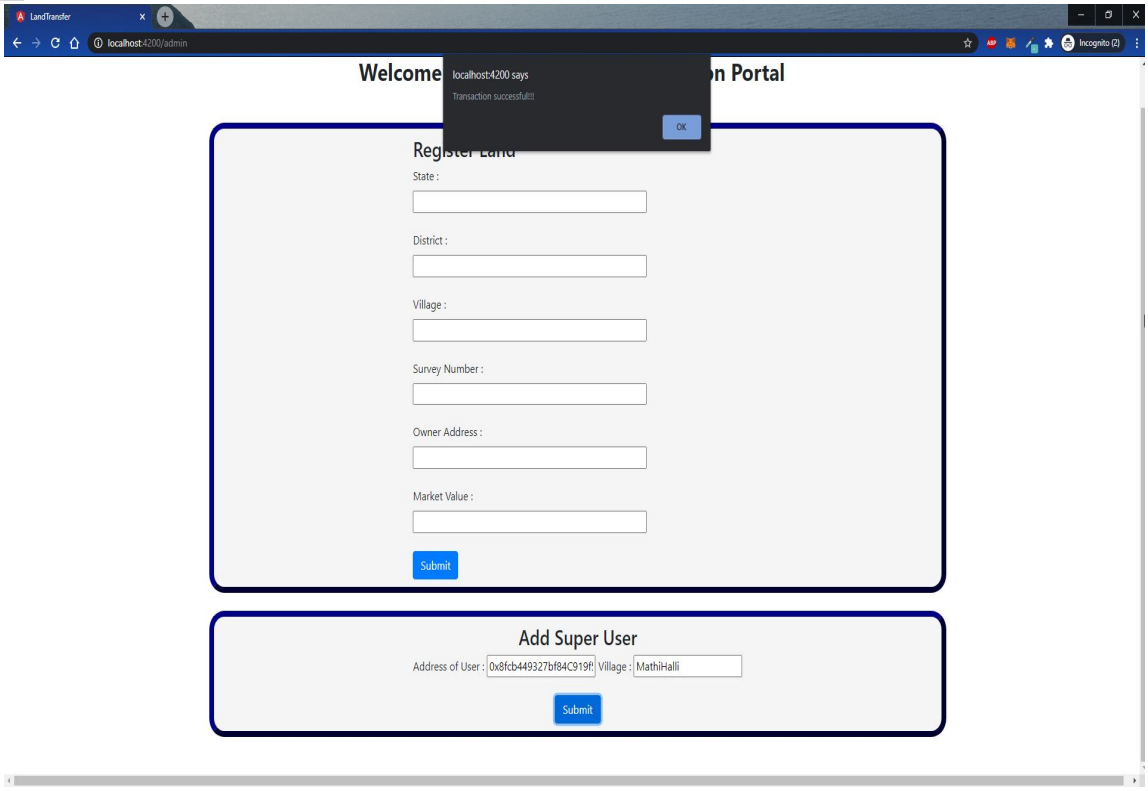

Fig. 7 Adding Super user

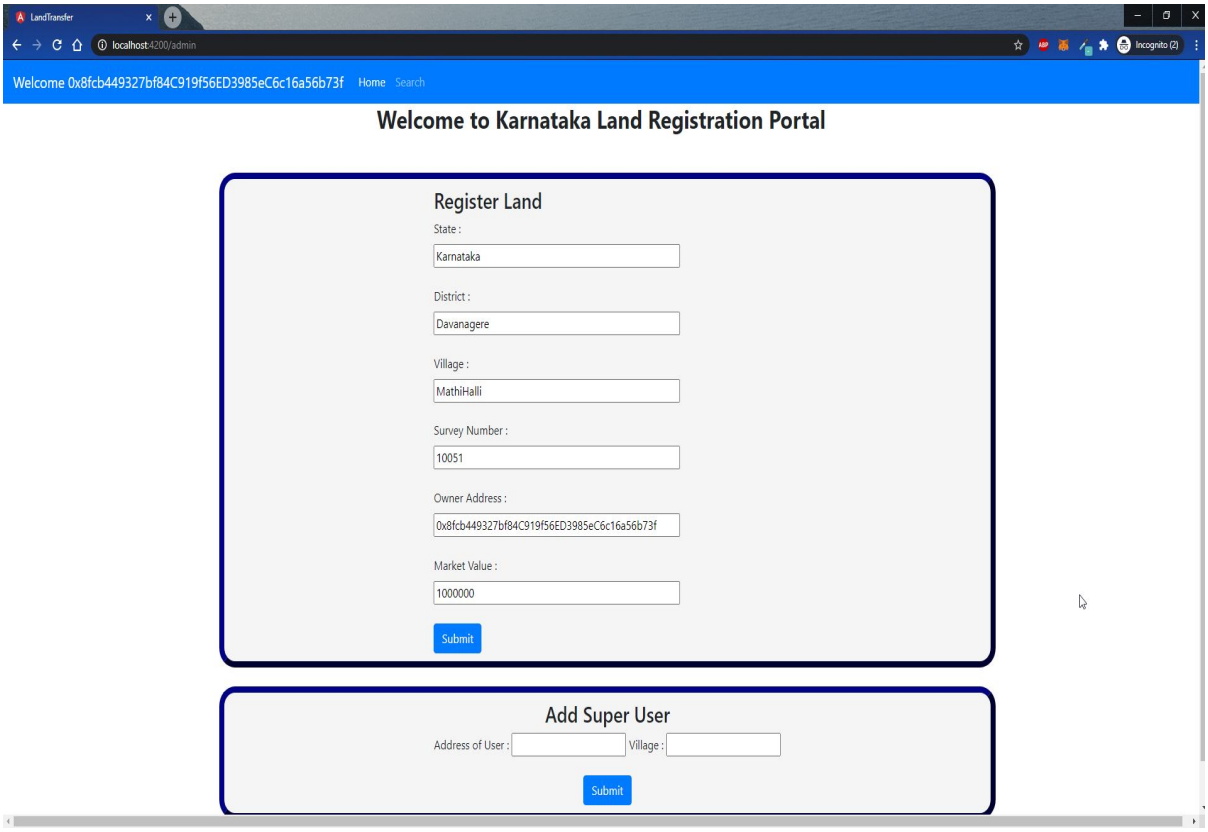

Fig. 8 Land Registering Process

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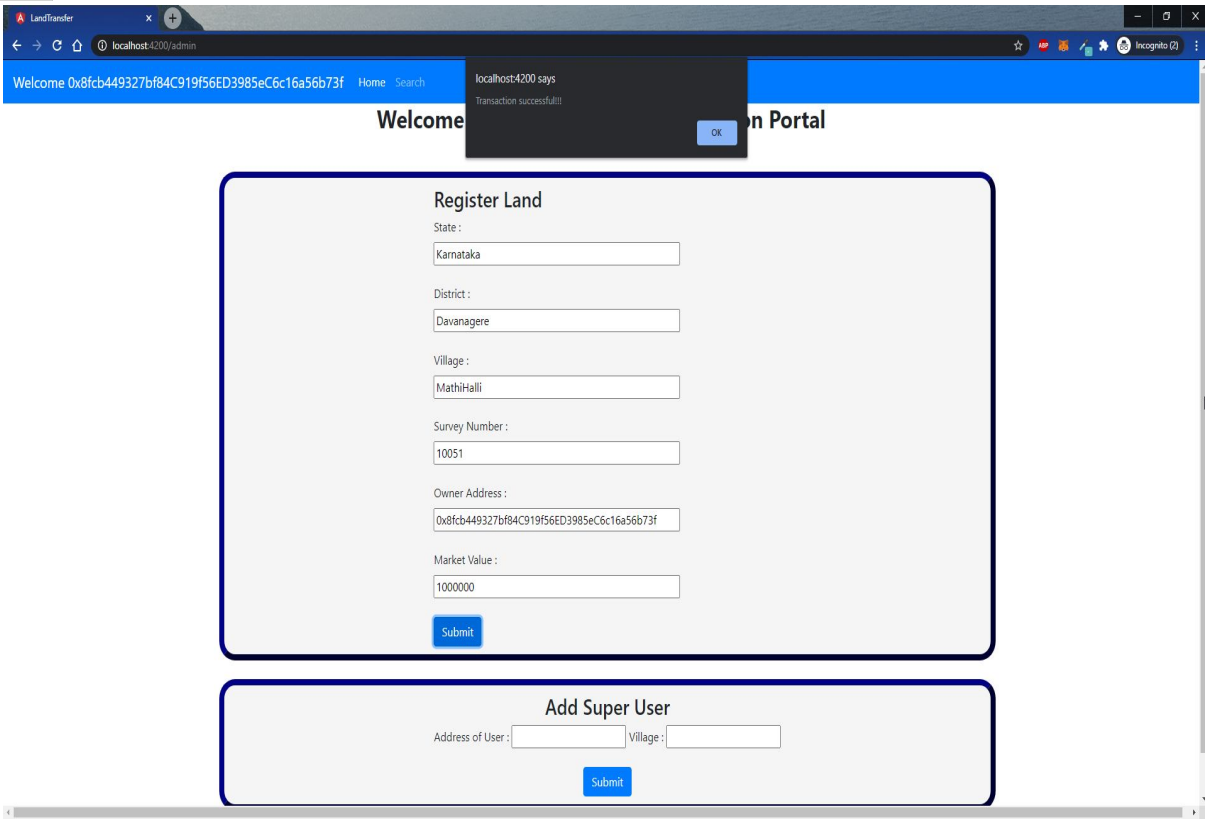

Fig. 9 Transaction successful

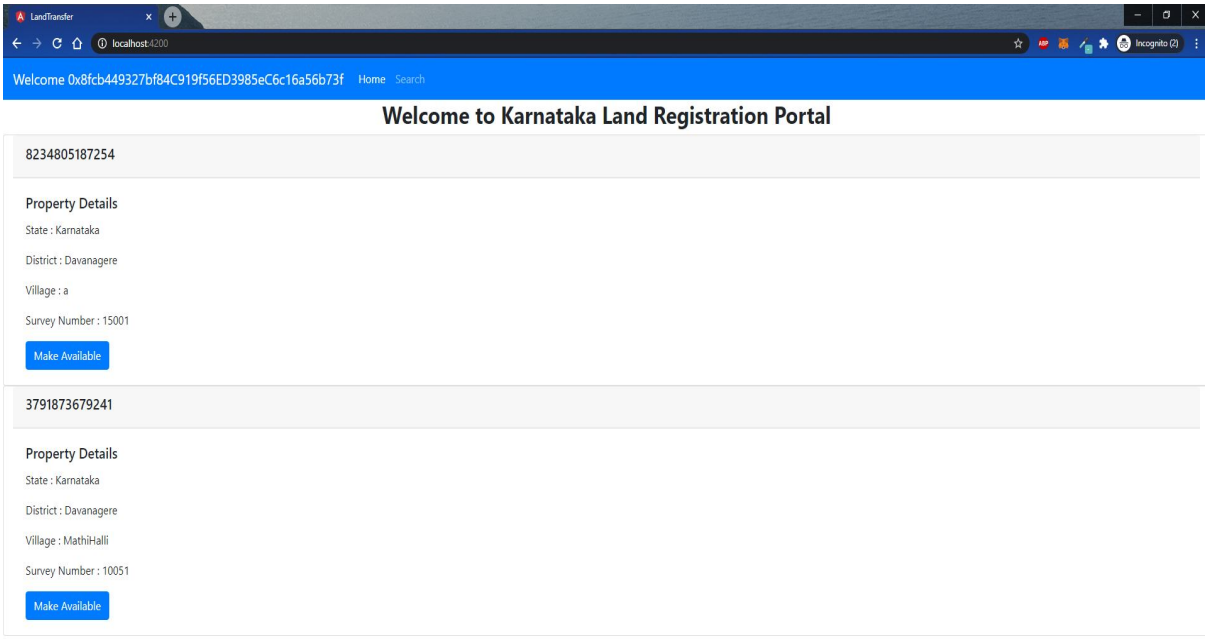

Fig. 10 Registered land Details

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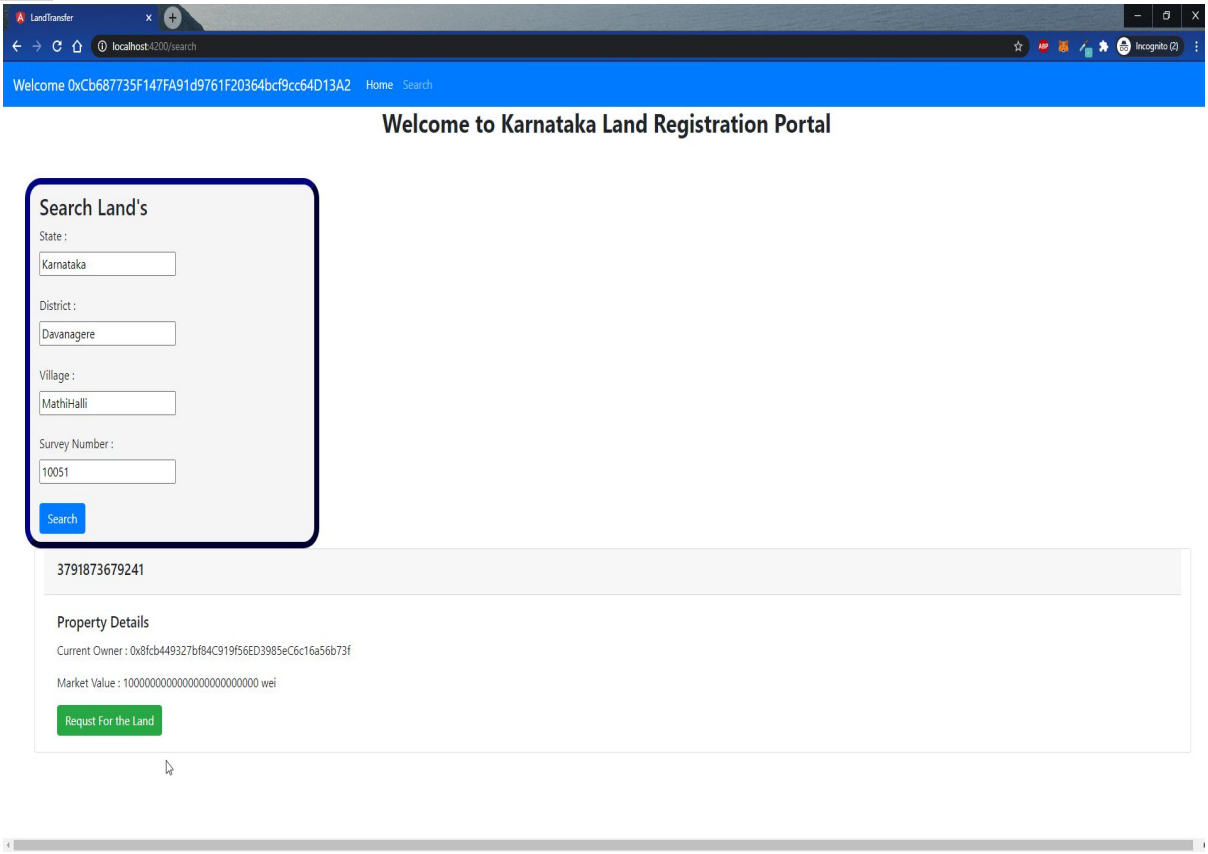

Fig. 11 Land searching by land details

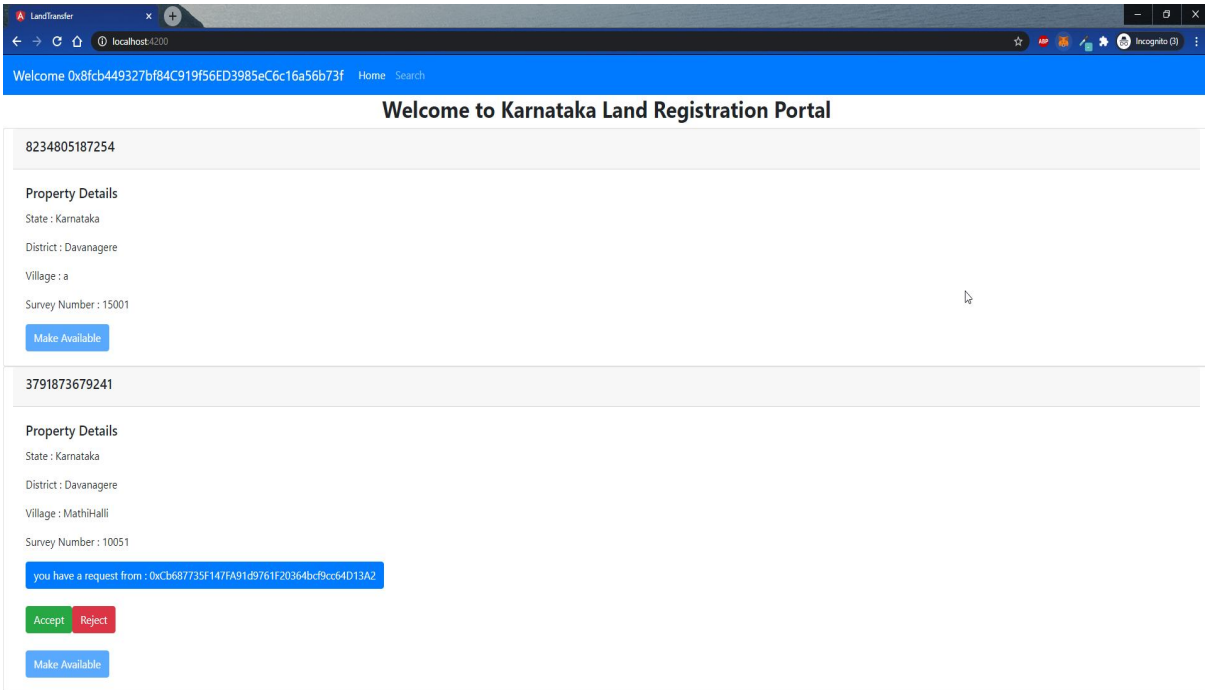

Fig. 12 requesting for land registration

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VII. CONCLUSION

Having the system which is able to prevent its data from unauthorized changes it is advantageous to the land administration and title registration process. This system will be able to solve conflicts in the society which are caused by one land plot having more than one owner. The system will be able to prevent corruption because the individuals who were able to make changes without been noticed it will be difficult for them to do that again. The system which has the capability of providing self-notarization in title registration process has the advantage of eliminating the number of days which were used for notarization in the issuance of land titles. This can eradicate the time of forty days recommended by LAND to just a single day (minutes). This study recommends the following; first, proposed model has to be implemented to the land infrastructure, because this will increase security whereby land title records will be prevented from both internal and external attacks. The proposed model can also be used in property registration, business registration and any other sort of registration which will require certification.

Second, disintegration in land administration and title registration process make difficult for normal transactions concerning land titles to take a lot of time. Land administration and title registration process should be uniform, this will simplify the process of coding land titles to the system and hence, will simplify transaction process. Third, regulators such as TCRA and TRA should start immediately to look how they formulate rules and laws concerning the blockchain technology. This technology has led to digital currency and is still going in other socio-economic sectors like agriculture, health, electricity, etc. Without a proper regulation, people can use this technology negatively.

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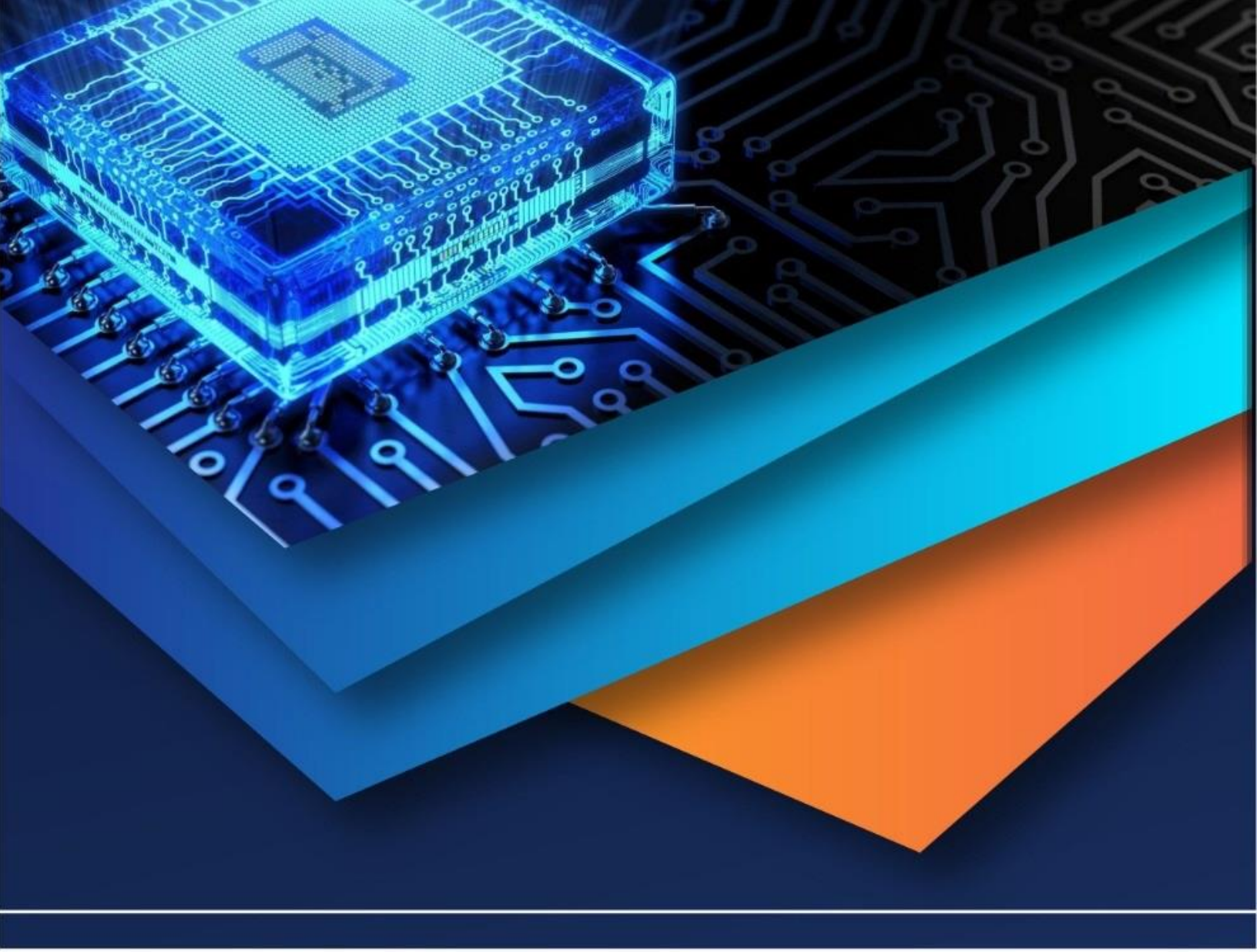

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