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AUTOMATIC GENERATION OF ETHEREUM-BASED SMART CONTRACTS FOR AGRI-FOOD TRACEABILITY SYSTEM

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Abstract**—** The project "**Automatic Generation of Ethereum-Based Smart Contracts for Agri-Food Traceability System"** is a growing demand for transparency along the agri-food chain, both from customers and governments. The adoption of blockchain technology to enable secure traceability for the management of the agri-food chain, provide information such as the provenance of a food product and prevent food fraud, is emerging rapidly, due to the inherent trust and inalterability provided by this technology. However, developing the right smart contracts for these use cases is even more of a challenge than it is for those used in other fields. Several management systems for the agri-food chain based on blockchain technology and smart contract have been proposed, all however ad-hoc for a specific product or production process and difficult to generalize. In this paper, we propose a new approach to easily customize and compose general Ethereum-based smart contracts designed for the agri-food industrial domain, to be able to reuse the code and modules and automate the process to shorten development times, while keeping it safe and reliable. Starting from the definition of the real production process, we aim to automatically generate both the smart contracts to manage the system and the user interfaces to interact with them, thus producing a system that works semi automatically. Additionally, we describe a honey production case study to show how our approach works. Future work will first extend the scope of the approach to other supply chains, furthermore, while the current platform used is Ethereum, in the future our approach will be easily extended to other blockchain platforms.

Keywords: Agri-foods,blockchain,supply,Ethereum.

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I. INTRODUCTION

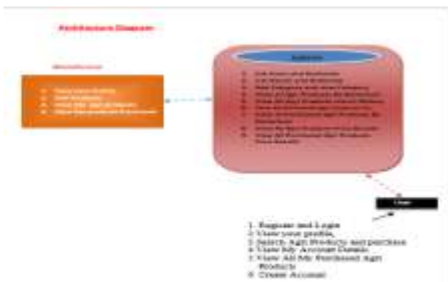
The project "**Automatic Generation of Ethereum-Based Smart Contracts for Agri-Food Traceability System"** is Blockchain technology is a new distributed, decentralized and immutable ledger database that can assure immutability and integrity of data without the need of a third trusted party. This is one of the reasons for which strong expectations exist on this technology to solve problems in sectors in which several untrusted actors have to work together, such as in the case of the agri-food industry. Blockchain technology appeared for the rst time in 2008 when one or more developers under the pseudonym Satoshi Nakamoto published a paper on a P2P electronic cash system [1] based on a digital currency called Bitcoin. This currency is based on a blockchain and does not need any intermediaries or central authority to transfer money from one person to another person. A blockchain is a specific type of distributed database able to store data in a secure and immutable way, and simultaneously to create transparency of the data history

II. OBJECTIVES

- It is based on a technological protocol that enables data to be exchanged with third parties within the P2P network without the need for intermediaries, because participants interact anonymously with encrypted identities, through transactions.
- Each transaction must be validated by a community of users through a consensus process, and then recorded in the ledger by adding it to an immutable chain of blocks holding the transactions stored in every network node.

- Many companies and startups are already adopting, and working on blockchain technology, trying to exploit themany advantages it promises, so we are experiencing a strong growth of ideas and applications

Architecture Diagram



PRELIMINARY INVESTIGATION

The first and foremost strategy for development of a project starts from the thought of designing a mail enabled platform for a small firm in which it is easy and convenient of sending and receiving messages, there is a search engine,address book and also including some entertaining games. When it is approved by the organization and our project guide the first activity, ie, preliminary investigation begins. The activity has three parts:

- **Request Clarification**
- **Feasibility Study**
- **Request Approval**

III. EXISTING SYSTEM

Alharby and Van Moorsel [15] found four issues that might face developers when writing smart contracts: i) the difficulty of writing correct contracts; ii) the inability to modify or terminate contracts; iii) the lack of support to identify under optimizedcontracts, and finally; iv) the complexity of SC programming languages

THE DRAWBACKS OF EXISTING SYSTEM

All SCs are not stored on every node of the blockchain. Ethereum uses a ``gas" mechanism, which is an internal pricing mechanism for all transactions running on it. To execute a transaction, it is necessary to pay a gas fee in Ethers, whose amount depends on the network overload.

The system is not implemented to avoid long computations and loops and can improve the allocation of resources and mitigate spam

IV. PROPOSED SYSTEM

Though the approach is targeted to the agri-food domain, it can be easily extended to many other types of supply chains, where a product, a service, or a shipment is delivered by assembling and working on parts, and/or passes through different types of transformations and state changes.

As far as we know, this is the first attempt to develop a semi-automatic configurable system that supports the entire class of supply chains for the agri-food industrial domain.

ADVANTAGES OF THE PROPOSED SYSTEM

- Immutability and transparency of data recorded on the blockchain, resulting in the traceability of agri-food products from root to retail
- Compliance with the quantities of the products involved (grapes, wine, bottles), based on the annual production of the land and the yield in the various stages of processing
- Ability to retrace the entire supply chain, simply by accessing the blockchain, and public servers storing relevant documents, starting from the QR code shown on the final product

CLASS DIAGRAM

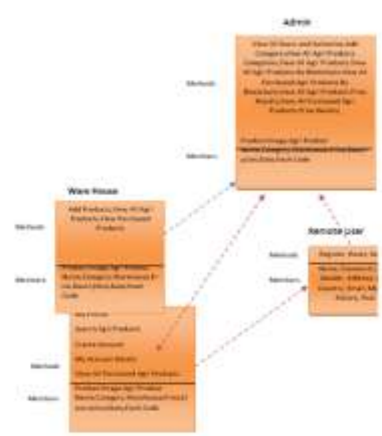


Figure2: class diagram

The class diagram is the main building block of object oriented modeling. It is used both for general conceptual modeling of the systematic of the application, and for detailed modeling translating the models into programming code. Class diagrams can also be used for modeling. The classes in a class diagram represent both the main objects, interactions in the application and the classes to be programmed.

In the diagram, classes are represented with boxes which contain three parts

- The upper part holds the name of the class
- The middle part contains the attributes of the class
- The bottom part gives the methods or operations the class can take or undertake

In the design of a system, a number of classes are identified and grouped together in a class diagram which helps to determine the static relations between those objects. With detailed modeling, the classes of the conceptual design are often split into a number of subclasses.

Use case diagram:

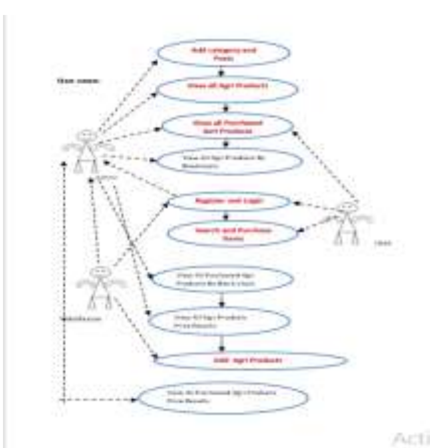


Figure 3: use case diagram

V. TESTING METHODOLOGIES

- Unit Testing.
- Integration Testing.
- User Acceptance Testing.
- Output Testing.
- Validation Testing.

Sequence Diagram:

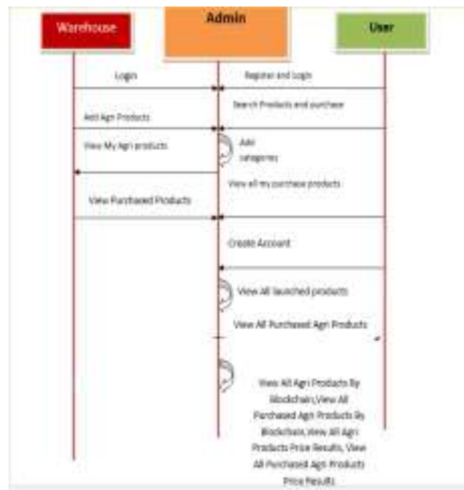


Figure 4: sequence diagram

VI. SYSTEM STUDY FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

1) ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited.

2)TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources

3)SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity.

VII. CONCLUSIONS

The project "**Automatic Generation of Ethereum-Based Smart Contracts for Agri-Food Traceability System"** we proposed a system enabling developers to quickly and smoothly develop traceability systems in the agri-food domain, without the need to grasp in every detail the technicalities of SC development, which is clearly different from classical software development. To this purpose, we accurately represented the problem domain, which was found suitable for such an approach, and developed a system able to automatically generate both the SCs and the UI of a tracing system . Systems based on blockchain technology and smart contracts, integrated with the Internet of Things, allow to implement a traceability system where the producers can share the responsibility to contribute information to their products, and independent third parts can identify themselves and certify the correctness of the data related to products' origin and quality.

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