CENG 485

Introduction to Blockchain Technology

Final Project

PLATFORM SCENARIO

Project Members

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Context Diagram

The producer will enter a new product into the system via a web page. This product information includes the Ethernet MAC Address, Product Serial Number and Motherboard Serial Number. The TrusTech system will generate a hash value from this information and upload it to the smart contract, and upload the product image to the IPFS system. In addition, all product information will be stored in a database. This process ensures the integrity and traceability of the product information. [2]

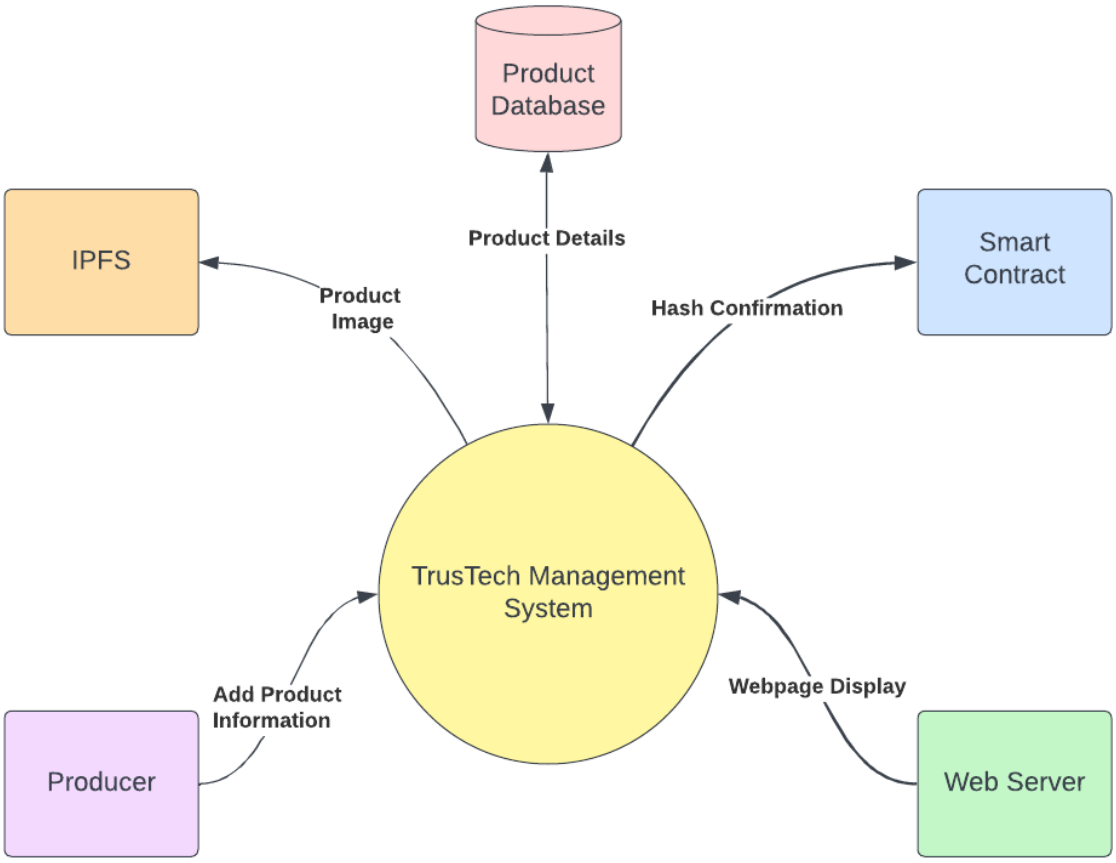

Figure 1: *Context Diagram of TrusTech [1]*

Use Case

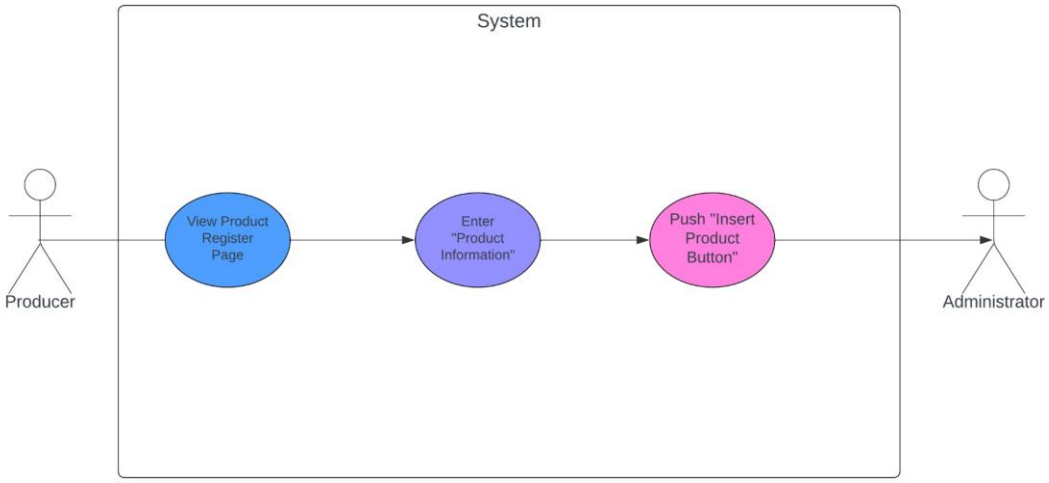

Figure 2: *Use Case of TrusTech [1]*

In this use case, producers aim to register their products on a website by providing three distinct features and an image. Upon clicking a push button, the website utilizes blockchain technology and a smart contract to securely store the hashed representation of these features using the SHA256 algorithm. Later, consumers can verify the legitimacy of a product by comparing the submitted features with the blockchain record. If the three features match, it indicates that the device's hardware remains unchanged, offering assurance to customers about the safety and authenticity of the product, even when sold as a second-hand item. This way of using blockchain makes sure everyone can see what's happening and that no one can mess with the information. It helps people feel sure about the quality of what they're buying. [3]

Components

Frontend

The user interface of the system was created using HTML, CSS and JavaScript. The technology we used is React Native. We gathered 4 text data from the user and 1 image from the user and we sent the data to the backend. The connection is established with a local network connection on port 5000. The data is converted to a JSON string from a JSON object with the data retrieved from the product register panel. Additionally, Smart Contract interaction was handled on the front-end.

Backend

The backend system of the TrusTech platform stores and updates critical information related to unique identifiers of each product which are used to validate product authenticity. The text file was used as the database system instead of SQLite. Additionally, the implementation of IPFS integration was handled by the backend rather than the frontend.

IPFS

Representative images regarding each product added to the platform are being uploaded to the IPFS system for distributed storage [4]. Pinata [5] IPFS system has been used for storing electronic device images that come from the front-end system.

Smart Contract

Contrary to the definition in the term paper, SHA256 text is generated on the smart contract itself, making the process less complicated from the platform users' perspective. Smart contract uses a mapping data structure to link SHA256 strings to product information structures. A user should be able to retrieve the related data to his/her device by querying this smart contract via creating a hash string with his/her device's hardware information.

Backstory

TrusTech, our innovative platform, integrates to verify both first and second-hand electronic devices. As a platform scenario, we play the role of an intermediate environment for producers and consumers such that we keep records of every unique device produced and serve this unique information to those who seek authenticity of their devices.

The frontend, developed with HTML, CSS, and JavaScript using React Native, ensures an intuitive user interface. The interface consists of 4 text inputs and 1 image, the frontend establishes a local network connection on port 5000 to send data to the backend. Smart Contract interaction is also managed on the frontend, streamlining user experience. The user interface of frontend can be seen in figure 3 and figure 4.

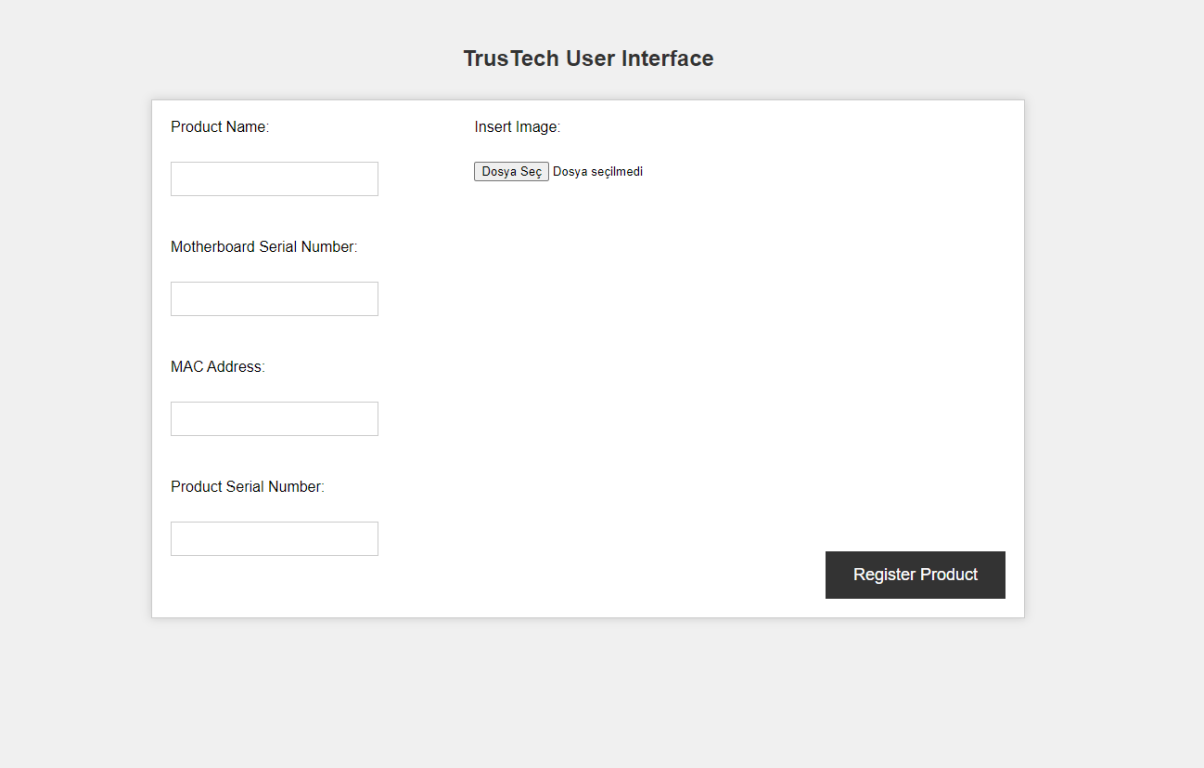

Figure 3: *The user interface of TrustTech*

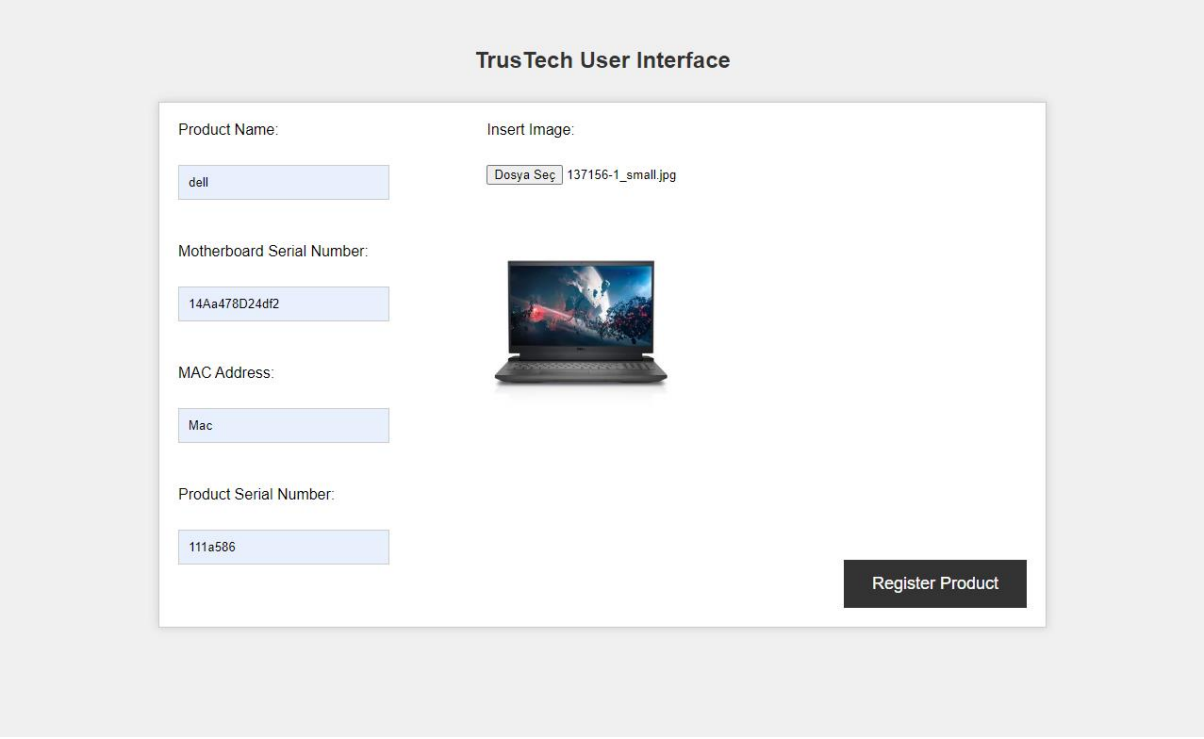

Figure 4: *The user interface of TrustTech with inputs*

The backend, significant for storing and updating unique product identifiers, employs text files as a database system instead of SQLite. This decision optimizes data handling. The backend integration of IPFS facilitates distributed storage of representative product images, enhancing accessibility and reliability through the use of Pinata's IPFS system.

IPFS, a pivotal component, ensures efficient storage and retrieval of electronic device images. Leveraging Pinata's IPFS system, TrusTech achieves a robust and decentralized image storage solution, contributing to the platform's overall resilience and scalability.

The Smart Contract, a cornerstone of TrusTech's security, generates SHA256 text within itself, simplifying the process for platform users. Using a mapping data structure, the Smart Contract associates SHA256 strings with product information structures. This approach streamlines user queries, allowing them to retrieve data about their device by creating a hash string with their device's hardware information.

In conclusion, TrusTech from frontend to backend, IPFS integration, and Smart Contract functionality, establishes a comprehensive solution for verifying the authenticity of second-hand electronic devices. The platform's use of cutting-edge technologies ensures transparency, security, and user-friendly interactions, setting a new standard in the evolving landscape of electronic transactions.

Personal Part

This course covered the fundamentals of blockchain, including the integral role of cryptocurrency, the process of verifying and adding transactions through consensus mechanisms, and the functionality of smart contracts. Topics such as hashes, blockchain mining, immutability, and the basics of Ethereum were also explored. The course delved into executing smart contracts on a blockchain with practical examples. Emphasis was placed on blockchain security, involving cryptographic principles. Additionally, the course touched upon decentralized applications (DApps), the impact of blockchain in various industries, and distinctions between Bitcoin and Ethereum. The Ethereum Virtual Machines (EVM) were highlighted. We also learned and practiced implementing NFTs, IPFS, Truffle, Ganache, and Hardhat Foundry.

A significant and enjoyable aspect for me was the introduction to coding on a blockchain platform and the development of simple smart contracts. This hands-on coding experience facilitated the term paper and project design process.

Collaborating with dedicated teammates, we brainstormed project scenarios, created context diagram, and use case. We decided on whether the implementation of the Smart Contract and IPFS integration would be handled by the frontend or the backend.

In addition, we gained experience in both backend and frontend development in our project. Simultaneously, we acquired practical knowledge in implementing smart contracts and database system and utilizing IPFS. Thanks to the IPFS implementation, I also learned how to use Pinata and integrate it with the backend.

Every team member demonstrated a strong willingness to contribute and put in effort. I was satisfied with the dedication of all my teammates, enjoying their company and fostering a positive and productive atmosphere. Our collaboration was both enjoyable and fruitful, leading to the acquisition of new knowledge and skills.

Apart from that, everyone fulfilled their responsibilities and provided mutual support throughout. Every team member efficiently completed their tasks within the shortest timeframe, ensuring a seamless process without causing any inconvenience. The team member who completed his / her own task helped other group members. This collective effort resulted in a successful team accomplishment.

Work percentage of each group member:

Doğa Melis ERKE - 100%
Özgün DOĞAN - 100%
Kaan BAYDEMİR - 100%
Ahmet Berkay ASLAN - 100%

Finally, I am grateful for the course instructors, as their expertise greatly contributed to my understanding of the Fundamentals of Blockchain. I feel fortunate to have had access to their knowledge, and thanks to them, I gained valuable insights and learned a great deal.

References

[1] Lucid Chart. [Online]. Available: https://www.lucidchart.com/pages [Accessed 16 November 2023]

[2] Vennegage. [Online]. Available: https://venngage.com/blog/context-diagram [Accessed 16 November 2023]

[3] Wikipedia. [Online]. Available: https://en.wikipedia.org/wiki/Use_case [Accessed 16 November 2023]

[4] IPFS Documents [Online]. Available: https://docs.ipfs.tech [Accessed 18 November 2023]

[5] Pinata Cloud [Online]. Available: https://www.pinata.cloud/ [Accessed 29 December 2023]