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Smart Contracts Vulnerability Analysis for Organ Donation and Transplantation Using Ethereum Blockchain Based Algorithms

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ABSTRACT: Donating an organ is one of humanity's most honorable actions to save the lives of patients through organ transplantation. For a successful transplant, the organ must be in acceptable working conditions with donor-recipient matching, and its removal should not pose a life-threatening risk to the donor. Organ donation is conducted in two different ways, including deceased donation and living donation. Managing organ donation and transplantation has become challenging due to the lack of data accountability, immutability, audit, transparency, traceability, and trust features in the existing systems. Comparative analysis between our solution and the existing blockchain-based solutions is presented. The comparison is performed using some important parameters, such as the used blockchain platform, mode of operation, smart contract development, tracing capability, real-time monitoring, implementation, and DApps development. Our solution and used the Ethereum network in a private mode of operation. In contract-based approach is proposed in and our solution only. Finally for our solution the front-end decentralized application for users to utilize the solution has not been developed, whereas and developed it for their solutions.

I. INTRODUCTION

Organ dysfunction or harm arises as a consequence of an injury or an ailment. This has an impact on one's standard of living and, on occasion, culminates in mortality. The inaugural successful instance of organ contribution transpired through a twin brother kidney transplantation in 1954. Subsequently, the annual count of transplants has experienced a steady augmentation. Nevertheless, the demand for organ contributions still surpasses the quantity of contributors. To elucidate, during the wait for an organ transplantation, twenty individuals meet their demise daily, and a fresh patient is incorporated into the queue every ten minutes. Of greater significance, gaining access to the organ donation queue is a fundamental prerequisite for organ allotment. The referral process for transplantation can be influenced by geographical and socioeconomic determinants. Thus, the allocation procedure on the queue should not be discriminatory against particular patient groups.

Organ contribution is conducted through two distinct modalities, comprising posthumous and living donation. Initially, the contributor undergoes assessment by the medical team specializing in transplants. In cases of posthumous donors, a cerebral death examination is conducted. Conversely, if the donor is still living, medical professionals evaluate the donor's fitness for live donation. Subsequently, all medical documents are submitted to the procurement coordinator. This entity is tasked with appraising the donor's state to ascertain their suitability and ensuring proper registration within the medical system. Following this, if the evaluation indicates the donor's eligibility for donation, the procurement coordinator conveys all pertinent data to the organ transplantation coordinator. This step can only be executed with the donor's explicit consent to donate to an anonymous recipient. Subsequently, the organ transplantation coordinator undertakes the task of matching potential donors with individuals on the waiting list. This culminates in the creation of a ranked index, furnished as an outcome and furnished to the transplantation surgeons. Thereafter, the transplantation surgeon determines the suitability of the organ for the patient, drawing from diverse considerations including the donor's medical dossier and the prospective recipient's present health. Subsequent to the acceptance of the donated organ by a transplantation surgeon, the donor's surgeon is apprised to undertake the extraction of the donated organ.



II. RELATED WORK

In non-blockchain-based processes, colorful approaches and tools are employed to come up with results that enhance organ donation, transplantation operation, and the matching process. The authors developed a multi-agent software platform to represent the information workflow model among patron hospitals, controllers, and philanthropist hospitals. This platform optimizes the pre-transplantation tasks, which can ameliorate the process effectiveness. In addition, it allows storing implicit patron information and improves direct communication among all actors in the organ transplantation process. An information workflow was dissembled using the advanced platform, and it was estimated that the saved time might be between three to five hours. The Trans Net is a system using scanning technology for barcodes at the point of organ recovery to help in labeling, packaging, and tracking organs and other natural accoutrements for transplantation. It involves supplementing the labeling system with an operation developed and a movable barcode printer corresponding with Donor Net. During organ recovery, procurement fellow will use the operating room’s system to publish markers and overlook all organs to be trans- ported. also, numerous force chain operation results have reckoned on barcodes, RFID markers, and Electronic Product Canons (EPC) for relating and participating product information to grease the shadowing of particulars through colorful phases. Eventually, the authors proposed a manageable medium, MIN, for the online matching of departed organs to benefactors to ameliorate effectiveness and fairness in opting cases within the current system in Australia. The MIN medium simply designates an arriving organ to a case that minimizes| KDPI- EPTS|, tie- breaking by time on the waiting list and latterly aimlessly. The order Donor Patient Index (KDPI) estimates the quality of the organ. On the other hand, the Anticipated Post-Transplant Survival Score (EPTS) measures the life quality of the philanthropist after the transplant. After testing, the results showed that the MIN medium outperforms the current medium under consideration by the Organ and Towel Authority in Australia.

III. METHODOLOGY

Describes the core components of the proposed methodology, including:

- a. Donor Registration:** How blockchain can facilitate secure registration of potential organ donors, maintaining their information confidentially and enabling easy updates.
- b. Organ Matching:** Explains how blockchain’s transparency and real-time updates can enhance the accuracy and speed of organ matching between donors and recipients.
- c. Consent Verification:** Explores how smart contracts can automate the consent verification process, ensuring that all parties involved are in agreement and transparently recorded on the blockchain.
- d. Real-time Monitoring:** Discusses the implementation of real-time monitoring of organ transportation and transplantation, minimizing the risk of organ theft or damage.

IV. EXPERIMENTAL RESULTS

To test this application, I am using below images to store the data in decentralized form. Fig1 displays the home page of the organ donation and transplantation. Fig2 displays the organ donation application page where user has to fill his details. Fig3 displays the review or experience of the user. Fig4 displays all users who has filled their details. Fig 5 displays organ donors who wanted their data to be secured. Fig 6 displays verification through blockchain. Fig 7 displays sentiment analysis. And finally figure 8 displays sentiment analysis graph.

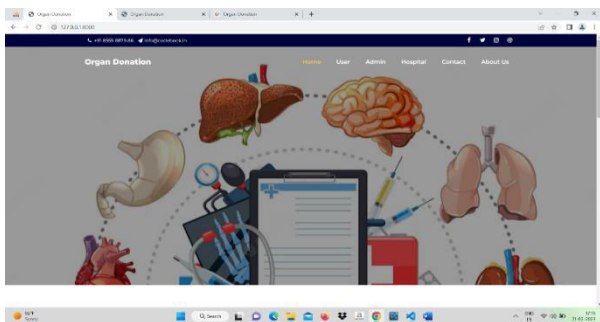


fig. 1.Home Page

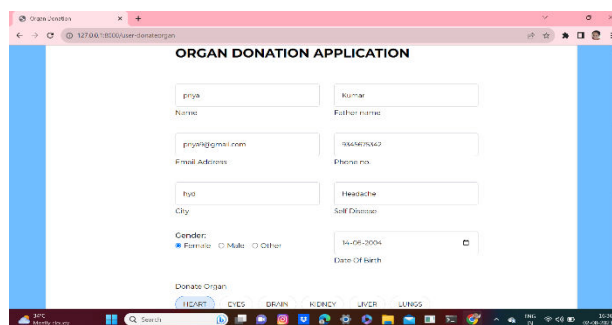


Fig. 2. Organ donation application

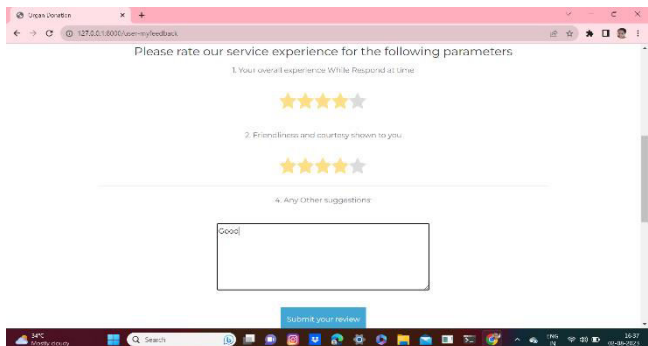


Fig. 3. User review/experience

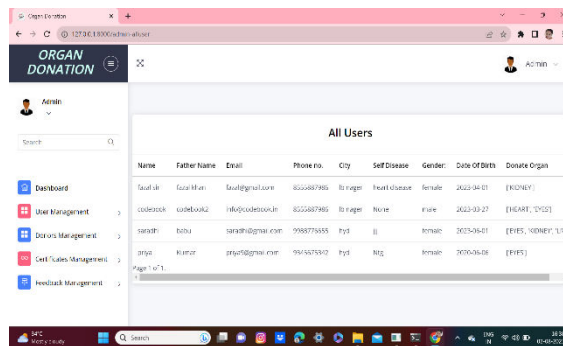


Fig. 4. All users

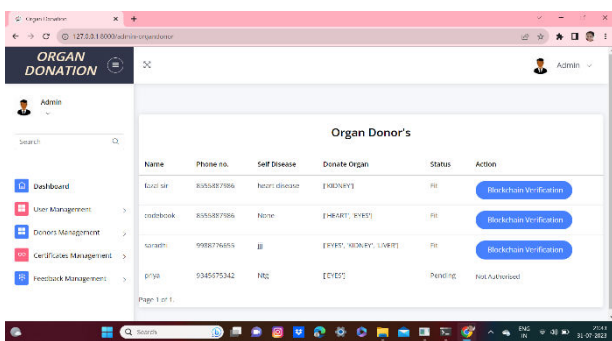


Fig. 4. Organ donors

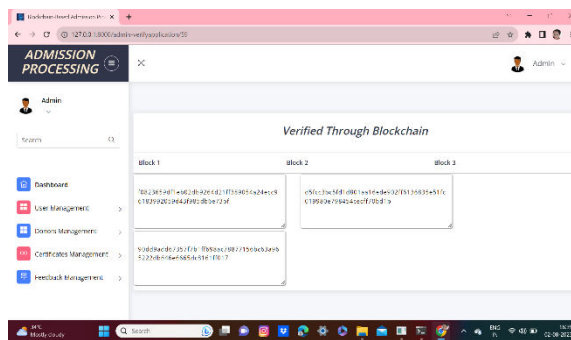


Fig.6. Blockchain verification

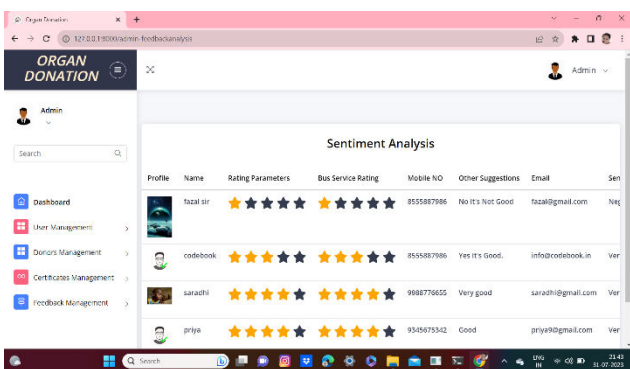


Fig. 7. Sentiment Analysis

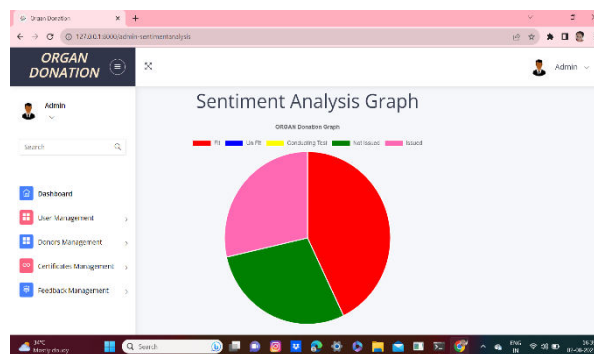


Fig.8. Sentiment Analysis Graph

V. CONCLUSION

In this paper, I have proposed a private Ethereum blockchain based solution that manages organ donation and transplantation in a decentralized, accountable, auditable, traceable, secure, and trustworthy manner. And also developed smart contracts that ensure the data provenance by recording events automatically. We present six algorithms with their implementation, testing, and validation details. We analyze the security of the proposed solution to guarantee that smart contracts are protected against common attacks and vulnerabilities. We compare our solution to other blockchain-based solutions that are currently available. We discuss how our solution can be customized with minimal effort to meet the needs of other systems experiencing similar problems. In the future, our solution can be improved by developing an end-to-end DApp. Furthermore, the smart contracts can be deployed and tested on a real private Ethereum network.



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