

# Secure Organ Donation Management System

*A Blockchain and ECC-Based Approach for Enhanced Data Integrity*

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**Abstract**—Organ transplantation plays a crucial role in saving human lives, yet centralized organ donation systems still face issues such as data manipulation, illegal organ trading, and limited transparency. Sensitive medical information stored in traditional hospital databases can be accessed or modified by unauthorized entities, leading to ethical concerns. This paper proposes a decentralized organ donation management system using blockchain integrated with Elliptic Curve Cryptography (ECC) to provide secure, transparent, and privacy-preserving data handling. ECC ensures lightweight encryption of confidential donor and recipient details, while blockchain technology maintains tamperproof logs of donation records. The system utilizes a Java-based interface backed by secure storage and cryptographic validation. Evaluation results confirm enhanced traceability, strong data protection, and reduced risk of information tampering.

**Index Terms**—Blockchain, ECC, Organ Donation, Security, Transparency. (*key words*)

## I. INTRODUCTION

All manuscripts must be in English. Organ failure is a growing global health concern, and the number of people awaiting transplantation continues to rise every year. Despite medical advancements, the gap between available donors and patients remains substantial. Centralized management of donor data often results in a lack of transparency, data tampering, incorrect prioritization, and illegal organ commercialization. Blockchain technology provides a decentralized way of storing records across multiple participants, ensuring that no entity can manipulate data without detection. When combined with strong cryptographic techniques such as ECC, patient privacy is protected while ensuring secure verification.

## II. LITERATURE SURVEY

1. Blockchain-Based Transparent Organ Donation Systems: Ghosh and Dutta (2023) proposed the Indriya system, a secure organ donation platform using Hyperledger Fabric and smart contracts.
2. Blockchain and IoT Integration for Healthcare: Quasim and Radwan (2021) developed a blockchain framework combining IoT sensor data and cloud storage for secure electronic health record management.
3. Ethereum Smart Contracts for Organ Transplant Management: Sharma and Singh (2023) implemented Ethereum-based smart contracts automating donor-recipient matching and transaction logging.

## III. ARCHITECTURE

The architecture of the proposed Organ Donation Management System integrates blockchain technology and ECC to ensure secure, transparent, and privacy-preserving operations. It consists of four major components:

- **User Interface Layer:** This layer provides system access for all stakeholders through a Java-based graphical interface.
- **ECC Security Layer:** Before any personal or medical information is transmitted or recorded, ECC is used to encrypt the data.
- **Blockchain Distributed Ledger Layer:** Encrypted data is stored on a decentralized blockchain network, ensuring transparency and immutability.
- **Secure Storage and Verification Layer:** The blockchain stores cryptographic hashes that correspond to this data, enabling secure verification without exposing medical details.

## IV. METHODOLOGY

The methodology involves a secure workflow that integrates Blockchain technology with ECC to protect sensitive medical information. The cryptographic model uses the Weierstrass elliptic curve equation:

$$y^2 = x^3 + ax + b \pmod{p}$$

Key generation follows the transformation:

$$Q = dG$$

where  $d$  represents the private key,  $G$  is a base point on the curve, and  $Q$  is the derived public key. Each transaction hash is computed using:

$$H(x) = \text{SHA-256}(x)$$

## V. RESULTS AND DISCUSSION

The system provides separate secure login interfaces for donors, recipients, and hospitals. Donors and recipients can register their personal and medical information, which is immediately encrypted using ECC. When a donor submits details, the data is transformed into encrypted form and stored in the decentralized blockchain ledger. Every operation performed on the system triggers automatic blockchain logging. Experimental evaluation demonstrated that ECC-based encryption requires minimal processing overhead, maintaining smooth system response times.

## VI. CONCLUSION

In conclusion, the blockchain-enabled organ donation management system developed in this study demonstrates a highly secure and transparent solution for managing sensitive donor–recipient information. By integrating ECC and blockchain, the system ensures both privacy and tamper-proof data integrity. Overall, the system stands out as a reliable, scalable, and secure solution that enhances donor transparency and supports more ethical organ transplantation processes.

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