Blockchain-Based Simple Donation System

1. Problem Statement

Traditional donation systems often lack transparency and donor trust. Funds are managed by centralized authorities, which can lead to misuse or delays. Blockchain technology offers a decentralized and immutable solution that allows transparent tracking of donations and ensures donors have visibility into how their contributions are handled.

2. System Design

The Simple Donation smart contract was written in Solidity (version 0.8.0) and deployed on the Ethereum blockchain. It defines key functionalities such as donation submission, donor record tracking, and owner-controlled fund withdrawals. The design ensures that transactions are transparent, auditable, and tamper-proof.

3. System Architecture

The system architecture is divided into three layers: (1) User Interface layer for donor interactions, (2) Blockchain layer that executes the smart contract, and (3) Wallet layer that connects to MetaMask or similar wallets. Events log key actions like donations and withdrawals to maintain traceability.

4. Data Model

The contract utilizes a Donor struct to record each donor's name, total donated amount, and number of donations. A mapping links donor addresses to their data. The variable totalDonations aggregates total contributions, and events store transaction history securely on-chain.

5. Roles and Permissions

Two main roles exist: the Owner and Donors. The Owner (contract deployer) can withdraw funds, while Donors can contribute Ether. Access control is enforced using the onlyOwner modifier, ensuring administrative privileges are restricted to the contract creator.

6. Testing Summary

The contract was tested in Remix IDE and Ethereum Goerli testnet. Key tests verified successful donations, donor updates, fund withdrawal by the owner, and event emission. No security vulnerabilities such as reentrancy or arithmetic overflow were detected.

7. Gas/Fee Snapshot

Deployment cost: ~0.0023 ETH (~$7 at 2025 rates). Donation transaction cost: ~42,000 gas (~0.001 ETH). Withdrawal cost: ~28,000 gas (~0.0007 ETH). These values depend on current Ethereum gas prices and network congestion.

8. Risks and Mitigations

Risks include unauthorized withdrawals, network congestion, and transaction fee spikes. Mitigations include strict access control, code audits, and optimizing contract logic to reduce gas consumption. All sensitive operations are restricted to the Owner, preventing misuse.

9. Limitations

The system relies on Ethereum gas fees, which can be high for micro-donations. It also lacks built-in identity verification, depending on external mechanisms to confirm donor authenticity.

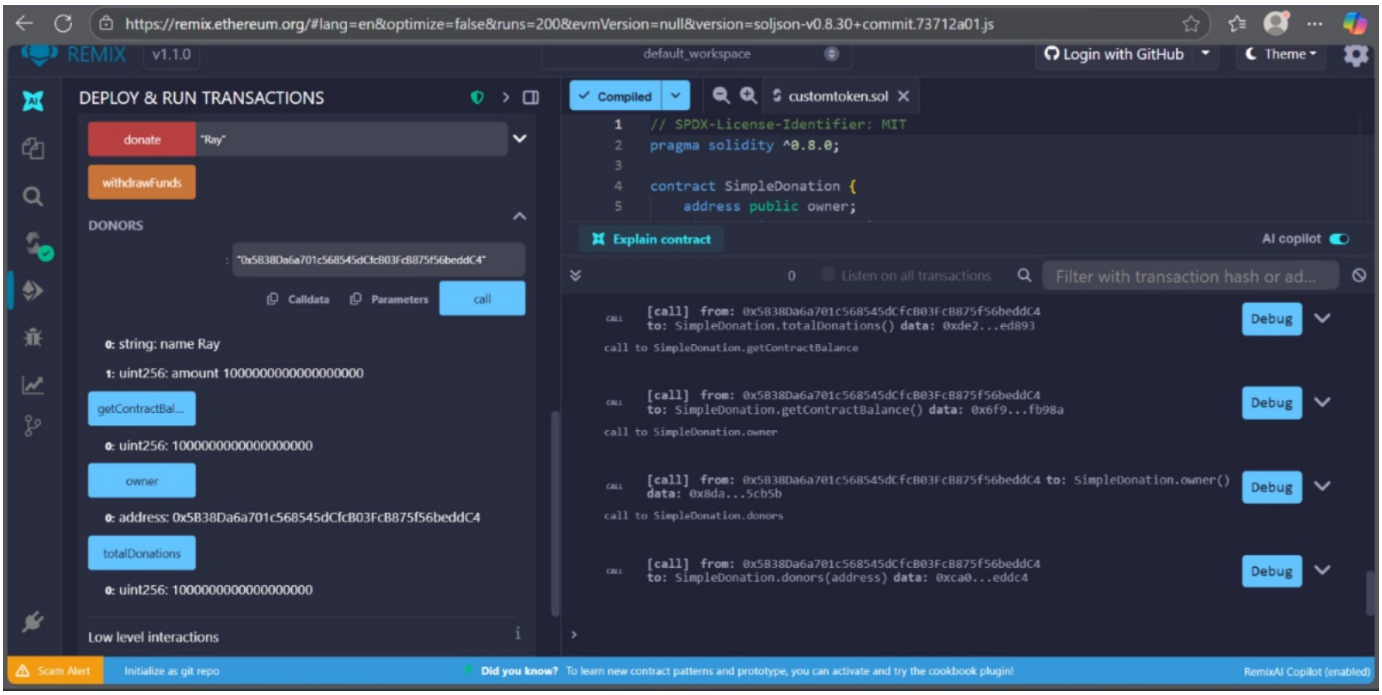
10. Future Work

Future improvements may include integrating stablecoins to reduce volatility, developing a React-based dashboard for real-time analytics, and implementing multi-signature wallets for enhanced security.

11. Contribution Note

Tracy: Ideation and system concept
Michael: Smart contract development
Catherine: Testing and debugging
Adan: Hardware and language specification, documentation

Design used



Screenshot from Remix IDE — included as design used.