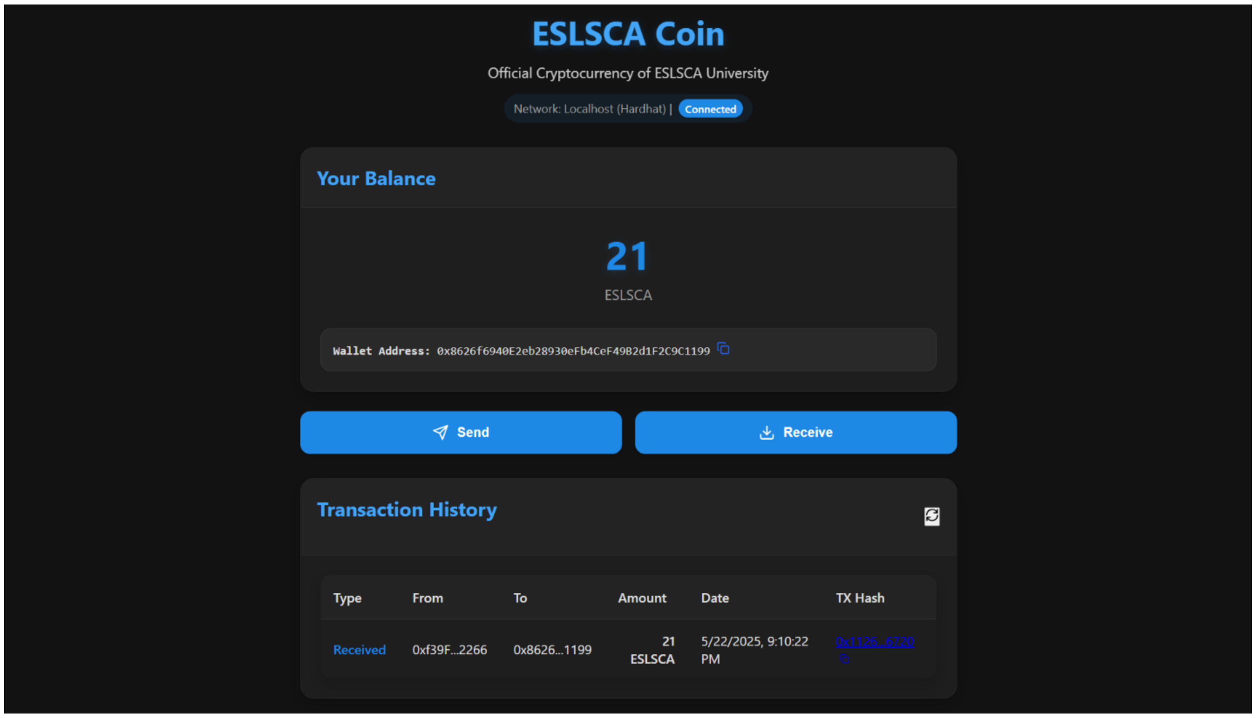
ESLSCA Coin - Project Documentation

1. Executive Summary

ESLSCA Coin is a fully functional ERC-20 token implementation deployed on the Ethereum blockchain, specifically designed for ESLSCA University. This project demonstrates the practical application of blockchain technology in creating a digital currency that can be transferred between users, with administrative capabilities for minting new tokens.

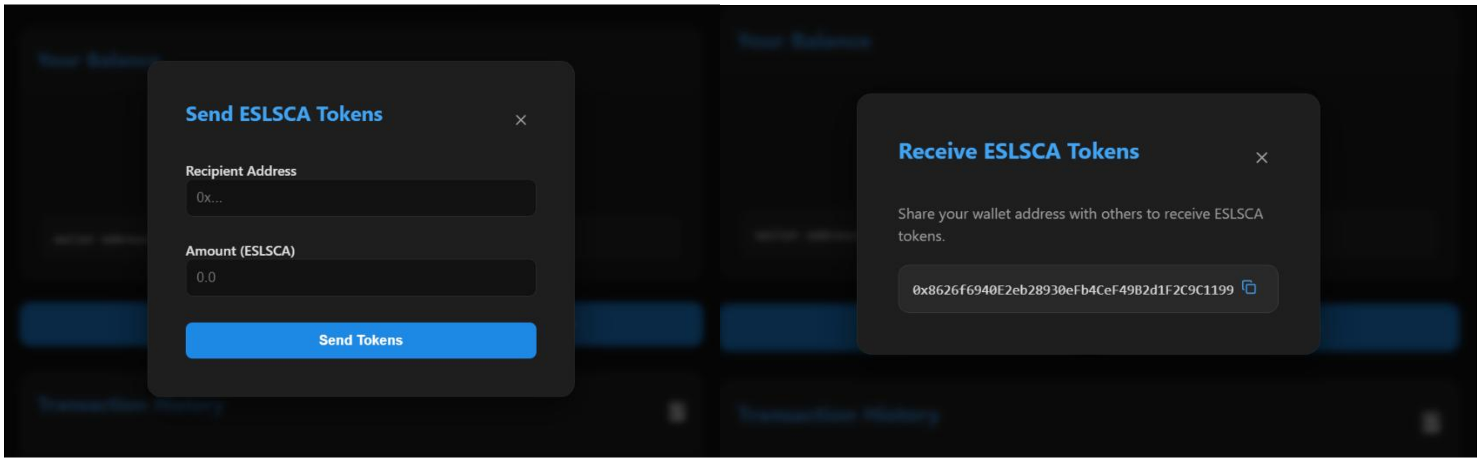
The project includes:

- A Solidity-based smart contract implementing the ERC-20 token standard
- A modern, responsive web interface for interacting with the token
- Comprehensive testing and deployment infrastructure
- MetaMask wallet integration


ESLSCA Coin
Official Cryptocurrency of ESLSCA University
Network: Localhost (Hardhat) | Connected
Your Balance
21
ESLSCA
Send
Receive
Transaction History

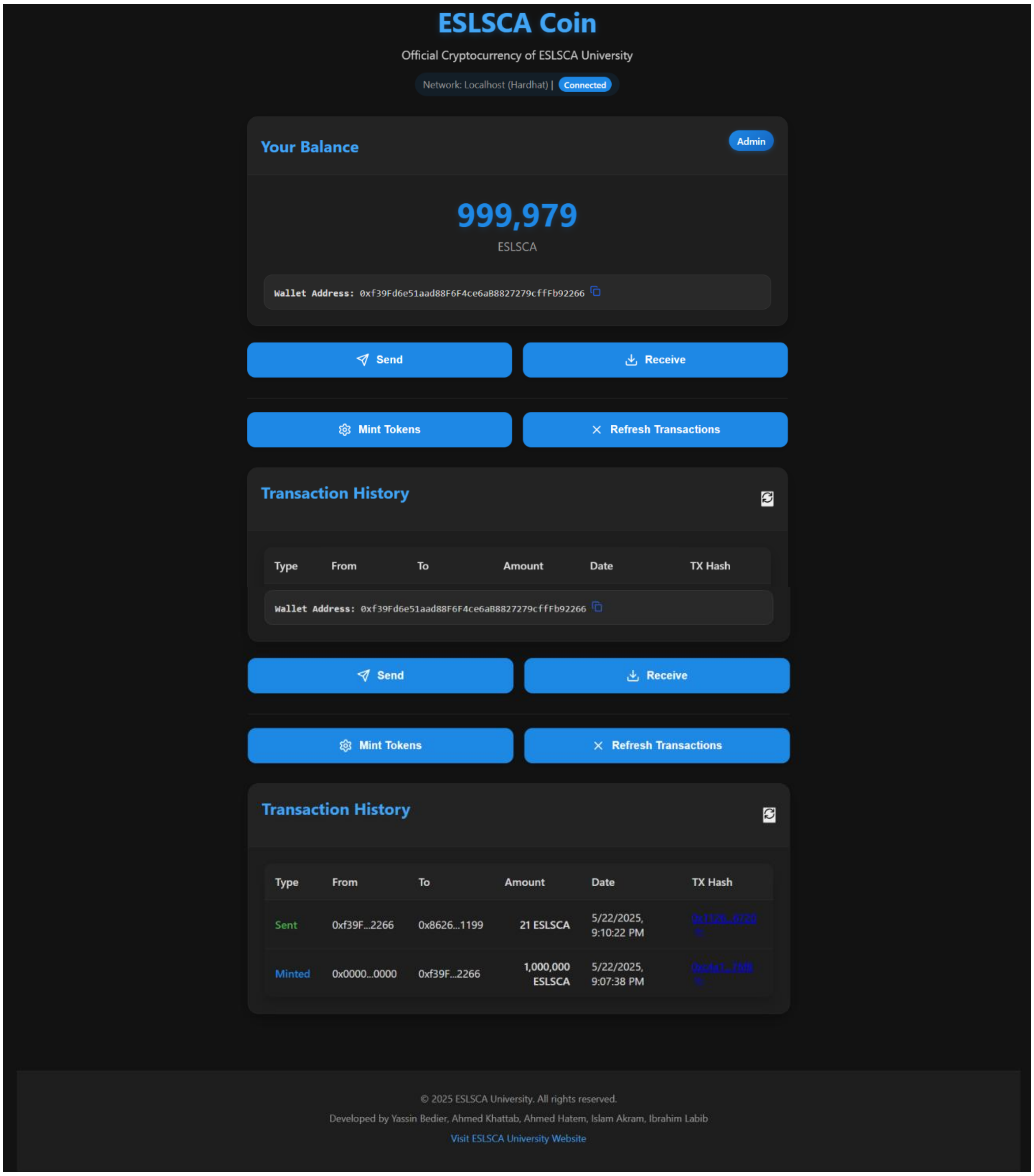
Wallet Address: 0x8626f6940E2eb28930eFb4CeF49B2d1F2C9C1199

Type	From	To	Amount	Date	TX Hash
Received	0xf39F...2266	0x8626...1199	21 ESLSCA	5/22/2025, 9:10:22 PM	0x1126...6720



Share your wallet address with others to receive ESLSCA tokens.

0x8626f6940E2eb28930eFb4CeF49B2d1F2C9C1199



ESLSCA Coin

Official Cryptocurrency of ESLSCA University

Network: Localhost (Hardhat) | Connected

Your Balance

Admin

999,979

ESLSCA

```
Wallet Address: 0xf39Fd6e51aad88F6F4ce6aB8827279cfFFb92266
```

Transaction History

Type	From	To	Amount	Date	TX Hash

```
Wallet Address: 0xf39Fd6e51aad88F6F4ce6aB8827279cfFFb92266
```

Send
Receive
Mint Tokens
Refresh Transactions

Transaction History

Type	From	To	Amount	Date	TX Hash
Sent	0xf39F...2266	0x8626...1199	21 ESLSCA	5/22/2025, 9:10:22 PM	0x112b...0720
Minted	0x0000...0000	0xf39F...2266	1,000,000 ESLSCA	5/22/2025, 9:07:38 PM	0x0da1...1b08

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2. Problem Statement

Traditional financial systems within educational institutions face several challenges:

- No change is found sometimes when buying from cafeteria, etc.
- Slow processing times for payments
- Limited transparency in financial operations
- Difficulty implementing reward systems for academic achievements

ESLSCA Coin addresses these challenges by providing a secure, transparent, and efficient digital currency specifically designed for the university ecosystem.

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3. Project Objectives

- Create a fully functional ERC-20 token with custom features for ESLSCA University
- Develop a user-friendly interface for managing tokens and transactions
- Implement secure administrative controls for token management
- Provide transparent transaction history and token traceability
- Ensure robust testing and deployment procedures
- Demonstrate practical application of blockchain technology in an educational context

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4. Technical Architecture

Smart Contract (Blockchain Layer)
The core of ESLSCA Coin is an ERC-20 smart contract built on the Ethereum blockchain. The contract leverages OpenZeppelin's well-audited libraries to ensure security and compliance with token standards.

Key components:

- `ESLSCACoin.sol`: Main contract implementing ERC-20 functionality with added features
- Custom event emissions for enhanced tracking
- Owner-restricted minting capabilities
- Additional utility functions for contract information

Frontend Application (User Interface Layer)
A React-based single-page application provides intuitive access to ESLSCA Coin functionality:

Key components:

- Wallet connection integration with MetaMask
- Token balance display
- Transfer functionality
- Transaction history
- Administrative interface for token minting

Development Infrastructure

- Hardhat: Development environment for compilation, testing, and deployment
- Ethers.js: Library for interacting with the Ethereum blockchain

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5. Smart Contract Details

ESLSCACoin Contract

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.20;

import "@openzeppelin/contracts/token/ERC20/ERC20.sol";
import "@openzeppelin/contracts/access/Ownable.sol";

/**
 * @title ESLSCACoin
 * @dev Implementation of ESLSCA Coin - A cryptocurrency for ESLSCA University
 */
contract ESLSCACoin is ERC20, Ownable {
    // Events
    event TokensMinted(address indexed to, uint256 amount, uint256 timestamp);
    event TransferExecuted(
        address indexed from,
        address indexed to,
        uint256 amount,
        uint256 timestamp
    );

    // Constructor
    constructor(
        string memory name,
        string memory symbol,
        uint256 initialSupply,
        address initialOwner
    ) ERC20(name, symbol) Ownable(initialOwner) {
        // Mint initial supply to the owner (initialSupply should already be in
wei)
        _mint(initialOwner, initialSupply);
        emit TokensMinted(initialOwner, initialSupply, block.timestamp);
    }

    /**
     * @dev Mint new tokens - only owner can mint
     * @param to Address to mint tokens to
     * @param amount Amount of tokens to mint (in wei - same units as
totalSupply)
     */
    function mint(address to, uint256 amount) public onlyOwner {
        require(to != address(0), "Cannot mint to zero address");
```

```solidity
        require(amount > 0, "Amount must be greater than 0");

        _mint(to, amount);
        emit TokensMinted(to, amount, block.timestamp);
    }

    /**
     * @dev Override transfer to add custom event
     */
    function transfer(
        address to,
        uint256 amount
    ) public virtual override returns (bool) {
        address sender = _msgSender();
        bool success = super.transfer(to, amount);
        if (success) {
            emit TransferExecuted(sender, to, amount, block.timestamp);
        }
        return success;
    }

    /**
     * @dev Override transferFrom to add custom event
     */
    function transferFrom(
        address from,
        address to,
        uint256 amount
    ) public virtual override returns (bool) {
        bool success = super.transferFrom(from, to, amount);
        if (success) {
            emit TransferExecuted(from, to, amount, block.timestamp);
        }
        return success;
    }

    /**
     * @dev Get contract information
     */
    function getContractInfo()
        public
        view
        returns (
            string memory tokenName,
            string memory tokenSymbol,
            uint256 totalTokenSupply,
            uint8 tokenDecimals,
            address contractOwner
        )
    {
        return (name(), symbol(), totalSupply(), decimals(), owner());
    }

    /**
     * @dev Get balance of an address
     */
    function getBalance(address account) public view returns (uint256) {
        return balanceOf(account);
    }
}
```

Key Contract Features

Standard ERC-20 Functionality:

- Transfer tokens between addresses
- Check balances
- Approve spending allowances

Enhanced Events:

- `TokensMinted`: Triggered when new tokens are created
- `TransferExecuted`: Provides additional data for token transfers

Administrative Controls:

- Only the owner can mint new tokens
- Security checks to prevent minting to zero address or zero amounts

Utility Functions:

- `getContractInfo()`: Returns comprehensive contract details
- `getBalance()`: Convenience method for checking token balances

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6. Frontend Application

Technology Stack

- React.js: Frontend framework
- Ethers.js: Ethereum interaction library
- CSS3: Custom styling with responsive design

Key Features

Wallet Integration:

- Seamless connection with MetaMask
- Account detection and display

- Network validation and switching

Token Management:

- Balance display with proper decimal formatting
- Token sending interface with validation
- Receipt of tokens via address sharing

Transaction History:

- Chronological list of all transactions
- Filtering by transaction type (sent, received, minted)
- Transaction details with links to blockchain explorer

Administrative Panel:

- Token minting interface (owner only)
- Batch operation capabilities

Error Handling:

- Comprehensive error detection and user feedback
- Multiple fallback mechanisms for blockchain interactions
- Clear success and error notifications

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7. Testing Strategy

A comprehensive testing approach ensures the reliability and security of the ESLSCA Coin implementation:

Smart Contract Tests

Deployment Tests:

- Verify correct owner assignment
- Confirm initial token supply allocation
- Validate token metadata (name, symbol, decimals)

Transaction Tests:

- Test token transfers between accounts
- Verify balance updates after transfers
- Ensure transactions fail with insufficient balances

Minting Tests:

- Confirm owner can mint new tokens
- Verify non-owners cannot mint tokens
- Validate restrictions on minting to zero address

- Test restrictions on minting zero amounts

Event Tests:

- Verify `TokensMinted` event emission
- Confirm `TransferExecuted` event with correct parameters

Utility Function Tests:

- Verify `getContractInfo` returns correct data
- Test `getBalance` functionality

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8. Deployment Process

The deployment process is automated to ensure consistency and reliability:

Local Development:

- Start local Hardhat node (`npm run node`)
- Deploy contract to local network (`npm run deploy`)
- Deployment information automatically saved to frontend

Frontend Deployment:

- Build optimized frontend (`cd frontend && npm run build`)
- Serve via appropriate web hosting

MetaMask Configuration:

- **Network:** Localhost (for development) or appropriate Ethereum network
- **RPC URL:** `http://127.0.0.1:8545` (local) or network provider
- **Chain ID:** 1337 (local) or appropriate network ID
- **Currency Symbol:** ESLSCA

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9. Security Considerations

Several security measures have been implemented to protect the ESLSCA Coin ecosystem:

Smart Contract Security:

- Use of OpenZeppelin's audited contracts
- Input validation for all public functions
- Access control via Ownable pattern
- Comprehensive testing of edge cases

Frontend Security:

- Transaction validation before submission
- Proper error handling and user feedback
- Protection against common web vulnerabilities

User Security:

- MetaMask integration for secure key management
- Transaction confirmation requirements
- Clear display of transaction details before signing

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10. Future Enhancements

The ESLSCA Coin project has several potential areas for future development:

Integration Capabilities:

- APIs for third-party applications
- Integration with university payment systems

Advanced Features:

- Staking mechanisms for rewards
- Tokens for scholarships
- Automated token distribution based on academic achievements

Enhanced Analytics:

- Advanced transaction reporting
- Token economics visualization

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11. Conclusion

ESLSCA Coin demonstrates a practical implementation of blockchain technology in an educational context. By providing a secure, transparent, and efficient digital currency, it addresses multiple challenges in traditional financial systems while offering enhanced capabilities for future innovation.

The project successfully fulfills its objectives of creating a functional ERC-20 token with custom features, developing a user-friendly interface, implementing secure administrative controls, and providing transparent transaction tracking.

12. Appendices

Appendix A: Installation and Setup

```
# Clone the repository
git clone https://github.com/Im2rnado/eslsca-coin.git
cd eslsca-coin

# Install dependencies
npm install
cd frontend && npm install && cd ..

# Compile contracts
npm run compile

# Run tests
npm test

# Start local blockchain
npm run node

# Deploy contract (in a new terminal)
npm run deploy

# Start frontend
npm run dev
```

Appendix B: User Guide

1. **Connecting Your Wallet:**
    - Install MetaMask browser extension
    - Configure MetaMask for the appropriate network
    - Click "Connect MetaMask" in the ESLSCA Coin application
2. **Viewing Your Balance:**
    - Your ESLSCA Coin balance appears in the Balance Card
    - The wallet address is displayed below the balance
3. **Sending Tokens:**
    - Click the "Send" button
    - Enter the recipient's address and amount
    - Click "Send Tokens" to confirm
4. **Receiving Tokens:**

- Click the "Receive" button
- Share your wallet address with the sender
- Copy address with the copy button

5. **Viewing Transaction History:**

   - Scroll down to the Transaction History section
   - View details of past transactions
   - Click "Refresh" to update the list

6. **Admin Functions (Owner only):**

   - Mint new tokens via the "Mint Tokens" button
   - Enter recipient address and amount
   - Click "Mint Tokens" to create new tokens