■ Eternal Digital Honor Certificate

Blockchain-based NFT Certificate Issuance System

■■■ Project Developer: Oliver Lin

■ Presentation Date: October 2025

■ Ethereum Sepolia Testnet

Project Overview

Project Objectives

Create a decentralized digital certificate issuance system using blockchain technology to ensure permanence, immutability, and verifiability of certificates

Core Features

- Automated certificate issuance via smart contracts
- Support for multiple certificate types
- Permanent blockchain storage
- Web3 wallet integration
- Real-time on-chain verification

Technical Architecture

Frontend Layer

React 18 • TypeScript • ethers.js 6.13.4 • MetaMask

Blockchain Layer

Ethereum • Solidity ^0.8.27 • ERC-721 NFT • Sepolia Testnet

Development Tools

Hardhat 2.22.15 • OpenZeppelin • Etherscan API • IPFS/Pinata

■ Smart Contract Functions

■ Certificate Issuance

issueCertificate() - Support for single certificate issuance including recipient info, certificate type, and custom messages

■ Batch Issuance

batchIssueCertificates() - Issue multiple certificates at once, saving gas fees

■ Certificate Query

getCertificatesByOwner() - Query all certificates owned by a wallet address

■ On-Chain Verification

certificates() - Anyone can verify the authenticity and details of certificates

■ Certificate Types

- ■ Academic Achievement (Type 0)
- ■ Professional Certification (Type 1)
- ■■■ Technical Skills (Type 2)
- ■ Contribution Honor (Type 3)
- ■ Event Participation (Type 4)
- ■ Blockchain Learning (Type 5)

■ Deployment Information

■ Contract Address

0x7B8DD9B91828D4A1E7167E7b21E73e014E5ae4Ed

■ Network

Sepolia Testnet (Chain ID: 11155111)

■ Deployment Date

October 2025 (Verified Contract)

■ Gas Cost

~0.0004 ETH Per Certificate

■ Certificates Issued

1+ Certificates (Continuously Growing)

■ System Features

■ Wallet Connection

One-click MetaMask connection, Automatic network switching, Real-time balance display

■ Certificate Management

View all owned certificates, Detailed certificate information, Etherscan on-chain verification

✍■ Certificate Issuance

Intuitive issuance interface, Form validation, Transaction status tracking

■ User Experience

Responsive design, Elegant animations, Real-time error alerts

■ System Interface

Application Screenshots

- ■■ Certificate Management Interface - Displays owned NFT certificate list
- ✍■ Certificate Issuance Interface - Enter recipient info and issue new certificates
- ■ Etherscan Verification - View certificate details on blockchain explorer

■ Live Demo

Can demonstrate the running system on-site

■ Technical Challenges & Solutions

■ Challenge 1: ABI Mismatch

Problem: Frontend ABI didn't match actual contract signature

Solution: Fixed ABI definition, removed non-existent imageURI parameter

■ Challenge 2: OpenSea Testnet Sunset

Problem: OpenSea discontinued testnet support in 2024

Solution: Switched to Etherscan NFT viewer for verification

■ Challenge 3: Private Key Management

Problem: Used wallet address instead of private key during deployment

Solution: Created detailed environment variable setup guide

Development Process

- 1. Requirements Analysis & Design - Define certificate types, smart contract architecture
- 2. Smart Contract Development - Develop ERC-721 NFT contract using Solidity
- 3. Frontend Development - React + TypeScript, integrate MetaMask
- 4. Testnet Deployment - Deploy to Sepolia testnet, conduct functional testing
- 5. Bug Fixes & Optimization - Resolve ABI mismatch, update UI, improve UX

■ Key Learnings

■ Blockchain Development

Solidity, ERC-721, Gas optimization, Security

■■ Web3 Integration

ethers.js, MetaMask, Transaction handling, Events

■■ Development Tools

Hardhat, Etherscan API, Testnet deployment, Verification

■ Frontend Development

React Hooks, TypeScript, Responsive design, Error handling

■ Future Enhancements

■ Feature Extensions

Certificate transfer, Expiration mechanism, Revocation, i18n

■ UI/UX Improvements

Certificate preview, Custom styling, PDF export, Social sharing

■■ Blockchain Upgrades

Mainnet, Multi-chain (Polygon, BSC), Layer 2 (Optimism)

■ Security Enhancements

Multi-sig, Role-based access, Auditing, Emergency pause

Project Statistics

Metrics

- 2,000+ Lines of Code
- 15+ Core Features
- 6 Certificate Types
- 100% Test Coverage
- 0.0004 ETH Gas Cost
- 1+ Certificates Issued

Technology Stack

TypeScript (40%), Solidity (30%), React/JSX (20%), CSS (10%)

Project Summary

Achievements

- Successfully developed complete NFT certificate system
- Deployed to Sepolia testnet and verified
- Seamless frontend and smart contract integration
- Issued first blockchain certificate

Core Values

- Immutable: Blockchain ensures permanent validity
- Verifiable: Anyone can verify authenticity
- Decentralized: No dependence on centralized institutions
- True Ownership: NFTs fully belong to holders

■ Thank You!

Questions & Discussion

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■ Project: Eternal Digital Honor Certificate