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BALMATTA, MANGALORE

PROJECT REPORT ON

"BLOCKCHAIN FOR SECURE DIGITAL IDENTITY MANAGEMENT"

SUBMITTED BY

MUNEEBA MARJAN

22BCACDC51

III BCA

(CYBER FORENSIC, CYBER SECURITY AND DATA ANALYTICS)

WITH IBM

UNDER THE GUIDANCE OF

MS. PRATHEEKSHA

LECTURER

DEPARTMENT OF COMPUTER SCIENCE

IN PARTIAL FULLFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF

BACHELORS OF COMPUTER APPLICATION

MAY 2025

CERTIFICATE

This is to certify that the project work entitled **"Blockchain for Secure Digital Identity Management"** has been successfully carried out in Graduate Studies and Research in Computer Science by **Muneeba Marjan (**Reg No: **22BCACDC51**), student of III BCA **(Cyber Forensic, Cyber Security and Data Analytics with IBM),** under the supervision and guidance of **Ms. Pratheeksha.**

Internal Guide: **Ms. Pratheeksha**

Chairperson:

Internal Examiner:

External Examiner:

PRINCIPAL

Prof (Dr.) Arun A. Bhagawath

The Yenepoya Institute of Arts, Science, Commerce and Management

(Deemed to be Unversity)

Submitted for the viva-voice

YENEPOYA
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Accredited by NAAC with 'A' Grade

DECLARATION

I MUNEEBA MARJAN bearing Reg. No. 22BCACDC51 hereby declare that this project report entitled "DIGITAL IDENTITY MANAGEMENT SYSTEM USING BLOCKCHAIN" had been prepared by me towards the partial fulfilment of the requirement for the award of the Bachelor of Computer Application at Yenepoya (Deemed to be University) under the guidance of Ms. PRATHIKSHA, Department of Computer Science, Yenepoya Institute of Arts, Science, Commerce and Management.

I also declare that this field study report is the result of my own effort and that it has not been submitted to any university for the award of any degree or diploma.

Place: Mangalore
Date: 29/05/2025

Muneeba Marjan
III BCA (CF, DA, CS)
22BCACDC51

ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to everyone who supported me during this project journey.

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I express my deep sense of gratitude to my Internal Guide **Ms. Prathiksha** for her constant guidance, constructive suggestions, and unwavering support. Her mentorship was instrumental in the successful completion of this project.

Finally, I thank my family, friends, and peers for their encouragement, cooperation, and moral support at every stage of this project.

Place: Mangalore

Date: 29/05/2025

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TABLE OF CONTENTS

ABSTRACT

The project titled **"Blockchain for Secure Digital Identity Management"** aims to build a decentralized and tamper-proof identity system using blockchain technology. Traditional identity management systems are often centralized and susceptible to data breaches, privacy violations, and single points of failure. This project introduces a secure, user-controlled, and transparent solution to digital identity verification using **Ethereum blockchain**, **Solidity smart contracts**, and **MetaMask wallet integration**.

The system provides functionalities for **identity registration, update, deletion, viewing, and admin-level verification** using **Role-Based Access Control (RBAC)**. Admins can verify or revoke identities, while regular users can manage their own. Identities are stored immutably on the blockchain, and frontend interactions are implemented using **HTML, JavaScript, and ethers.js**. The project also includes advanced features like **pagination**, **filtering**, and **multiple identities per user**.

By removing centralized intermediaries and providing users with direct control over their digital identities, this system strengthens privacy, enhances data integrity, and serves as a secure foundation for digital identity management in various domains such as healthcare, education, and finance.

1. INTRODUCTION

1.1. Overview of the project

This project, Blockchain for Secure Digital Identity Management, is designed to provide a decentralized and immutable platform for users to manage and control their digital identities. The system is built on Ethereum blockchain and leverages smart contracts written in Solidity to enable secure identity registration, retrieval, update, and deletion. Role-Based Access Control (RBAC) ensures that administrative operations like verification and revocation are limited to authorized personnel only.

The platform utilizes MetaMask for wallet-based authentication and ethers.js for blockchain interaction from the frontend. The goal is to eliminate dependency on centralized servers, reduce the risk of identity fraud, and give users ownership of their personal data.

1.2. Objective of the project

- To develop a decentralized digital identity management system using Ethereum blockchain.
- To enable users to create, update, and delete identities securely through a smart contract.
- To implement Role-Based Access Control (RBAC) so that only admins can verify or revoke identities.
- To allow multiple identities per Ethereum address, supporting diverse identity use cases.
- To incorporate pagination and search filters for scalability and improved user experience.
- To ensure data immutability, privacy, and integrity using blockchain principles.

1.3. Project Category

This project falls under the category of **Cybersecurity and Blockchain Technology**, specifically focused on **Secure Digital Identity Management**. It integrates principles from **smart contract development**, **Web3 interaction**, **frontend integration**, and **secure decentralized systems**.

1.4. Tools and Platforms to be Used

The project utilizes a wide range of tools, frameworks, and platforms that facilitate the design, development, deployment, and testing of a secure decentralized digital identity management system. These include:

- **Ethereum** – Public blockchain platform to deploy the smart contract.
- **Solidity** – Programming language used to write smart contracts.
- **Hardhat** – Development framework for compiling, testing, and deploying smart contracts locally.
- **MetaMask** – Browser extension wallet for interacting with Ethereum-based applications.
- **Ganache** – Local Ethereum blockchain simulator for testing smart contracts.
- **Node.js & npm** – Runtime and package manager for JavaScript dependencies.
- **ethers.js** – JavaScript library for blockchain interactions via Ethereum nodes.
- **HTML, CSS, JavaScript** – Used to develop the frontend interface of the DApp.

1.5. Overview of the Technologies Used

1.5.1. Hardware Requirements

A machine with:

- Processor: Intel i5 or higher
- RAM: Minimum 8 GB
- Disk Space: At least 20 GB of free storage
- Web browser (e.g., Brave or Chrome with MetaMask extension)

1.5.2. Software Requirements

- Operating System: Windows/Linux/macOS
- IDE/Editor: Visual Studio Code
- Node.js: v18 or later
- npm: v9 or later
- Hardhat: For smart contract development and testing
- Ganache: For running a local Ethereum network
- MetaMask: Browser extension for wallet authentication
- Browser: Brave or Chrome

1.5.3. Programming Languages

- Solidity – Smart contract development
- JavaScript – Frontend logic and ethers.js integration
- HTML & CSS – User interface structure and styling

1.6. Organizational Profile

This project is an academic initiative that reflects modern organizational needs for secure digital identity solutions, particularly in domains where authentication, data privacy, and verifiability are essential—such as healthcare, education, banking, e-governance, and public sector records.

Though this project is individual and academic, it simulates a real-world decentralized identity application that institutions can deploy securely on the blockchain.

1.7. Structure of the Program

The application is composed of the following modules:

1. **Wallet Connection:**

Connects a user's MetaMask wallet and verifies their address on the Ethereum network.

2. **Identity Registration:**

Users can register one or more identities containing name, age, email, gender, and location.

3. **Identity Viewing:**

Users can view their own identities; admins can view all identities on the system.

4. **Update/Delete Identity:**

Users can update or delete any of their own identities.

5. **Role-Based Access (RBAC):**

Admins can:

- View all identities
- Verify or unverify identities
- Revoke/delete any identity
- Add or remove admin privileges from any address

6. **Pagination & Filters:**

Admin identity dashboard supports paginated display and filtering based on status or keywords.

7. **Smart Contract:**

Contains all logic for identity registration, update, delete, view, and admin controls.

8. **Frontend UI:**

Built using HTML, CSS, and JavaScript to interact with the smart contract via ethers.js and MetaMask.

1.8. Statement of the Problem

In traditional identity management systems, personal data is stored in centralized databases that are prone to:

- Unauthorized access and breaches
- Data tampering or loss
- Lack of transparency
- Limited user control

Moreover, most systems don't allow users to manage multiple identities (e.g., personal, work, health) independently, nor do they offer verifiable authentication across institutions.

This project addresses these limitations by:

- Using blockchain to store and verify identities immutably
- Empowering users to manage their data directly using wallet authentication
- Enabling admins to verify or revoke identities transparently
- Supporting multiple identities per user
- Providing a secure, tamper-resistant, and user-controlled platform for identity management

2. SOFTWARE REQUIREMENTS SPECIFICATION

2.1. Introduction

2.1.1. Purpose:

The purpose of this document is to define the functional and non-functional requirements of the project titled “Blockchain for Secure Digital Identity Management”. It ensures a clear understanding of the system's capabilities, limitations, and user expectations. This document also serves as a foundation for design, implementation, testing, and evaluation of the DApp (Decentralized Application).

2.1.2. Scope of the project:

The project aims to develop a decentralized identity management system using Ethereum blockchain technology. The major features include:

- Wallet-based identity management (MetaMask)
- Identity registration, update, and deletion via smart contract
- Role-Based Access Control (RBAC)
- Admin verification and revocation of identities
- Support for multiple identities per account
- Admin-level view of all identities
- Pagination and filtering in identity dashboards
- The system provides a tamper-proof solution to traditional centralized identity storage and gives users control over their personal data in a decentralized manner.

2.1.3. Intended audience and reading suggestions:

- Developers and Blockchain Engineers: Interested in smart contract architecture and Web3 integration.
- Security Analysts: Evaluating privacy, access control, and decentralized authentication.
- Academic Evaluators: Assessing the project's technical implementation, innovation, and alignment with course outcomes.
- General Users and Admins: Who will interact with the decentralized platform via MetaMask.

2.1.4. Definitions, Acronyms, and Abbreviations:

Term	Meaning
DApp	Decentralized Application
RBAC	Role-based Access Control
UI	User Interface
ETH	Ether (cryptocurrency on Ethereum)
SMC	Smart Contract
EOA	Externally Owned Account (user wallet)

2.1.5. References:

- Ethereum Developer Documentation – https://ethereum.org/en/developers/docs/
- MetaMask Documentation – https://docs.metamask.io/
- Hardhat Docs – https://hardhat.org
- ethers.js Library – https://docs.ethers.org
- Solidity Language Guide – https://docs.soliditylang.org

2.1.6. Overview:

This chapter provides an in-depth description of the system's functionality, interfaces, design constraints, and performance requirements. It also details the technical environment, user interface expectations, and operational assumptions.

2.2. Overall Description

2.2.1. Product perspective:

This DApp is a self-contained identity management system built entirely on theEthereum blockchain. It includes:

- A Solidity smart contract deployed to the blockchain
- An HTML + JavaScript frontend with ethers.js integration
- Role-based access with different capabilities for users and admins
- No centralized database or backend server is involved. The blockchain acts as the storage and execution environment.

2.2.2. Product features:

- User Wallet Authentication: Login with MetaMask wallet.
- Identity Management: Register, update, and delete identities linked to wallet addresses.
- RBAC: Admins can verify/unverify/delete identities and manage admin roles.
- Multiple Identities per Address: One address can manage multiple records.
- Pagination & Filter: Admins can browse and search identities efficiently.
- Smart Contract Security: Access restrictions are implemented using require statements in Solidity.

2.2.3. User characteristics:

- Users: Ethereum wallet holders using MetaMask. Can manage their own identities.
- Admins: Special role users who can verify or revoke identities and manage other admins.
- Developers: Should be familiar with Solidity, ethers.js, and blockchain testing environments.

2.3. Operating Environment:

2.3.1. Design and Implementation Constraints:

- Frontend supports only MetaMask-compatible browsers
- All Ethereum transactions require wallet confirmation and incur gas costs (testnet or local)
- Smart contract must be deployed to a Hardhat/Ganache local chain or Ethereum testnet (e.g., Goerli)

2.3.2. General Constraints:

- Internet connection is required for wallet access and blockchain transactions
- Ethereum gas fees must be paid in ETH (on testnet or local network)
- The application runs entirely in the browser and does not support mobile devices by default

2.3.3. Assumptions and Dependencies:

- MetaMask is installed and connected
- The smart contract is compiled and deployed using Hardhat
- The user has test ETH to perform transactions
- No third-party centralized database is used
- Ganache/Hardhat node is running if testing locally

2.4. Specific Requirements

2.4.1. External Interface Requirements:

2.4.1.1. User interface:

- MetaMask wallet connection button
- Forms for identity registration and update
- Admin dashboard with paginated identity cards
- Action buttons for verify, unverify, delete, etc.

2.4.1.2. Hardware interface:

- Standard computing device (PC/laptop)
- Compatible browser (e.g., Chrome, Brave)

2.4.1.3. Software interface:

- ethers.js for frontend → smart contract interaction
- MetaMask for transaction signing
- Hardhat for smart contract deployment

2.4.1.4. Communication and interface:

- JSON-RPC via ethers.js to interact with Ethereum nodes
- ABI decoding and function encoding via smart contract interface

2.4.2. Functional Requirements:

- FR1: Connect to MetaMask wallet
- FR2: Register one or more identities per address
- FR3: View all identities associated with your address
- FR4: Update/Delete your own identity records
- FR5: Admin can view all identities on the system
- FR6: Admin can verify/unverify/delete any identity
- FR7: Admin can add or remove other admins

2.4.3. Performance Requirements:

- UI operations should execute in under 500ms (excluding transaction mining time)
- Pagination should limit the number of cards to 5–10 per page for performance
- Smart contract functions should complete in <1 second on a local network

2.4.4. Design Constraints:

- Only MetaMask-compatible browsers supported

- Transactions must be confirmed manually
- All identity logic must reside in the smart contract

2.4.5. Other Requirements:

- Maintain modular JS functions for clarity
- Smart contract code must be reusable and optimized for gas
- Comments and documentation must be present for all scripts

3. SYSTEM ANALYSIS AND DESIGN

3.1. Introduction

This chapter elaborates on the functional design, data flow, and structural representation of the digital identity management system. The system is designed to ensure that each module (user, admin, and smart contract) works in coordination to provide a seamless user experience and secure blockchain transactions. Diagrams like Data Flow, ER Diagram, Use Case, Class Diagram, and Sequence Diagrams explain the interaction of system components.

3.2. Data Flow Diagram (DFD)

Level 0:

- Shows a user interacting with the system via the frontend, which connects to the Ethereum blockchain through MetaMask.

Level 1:

- User submits form → JavaScript frontend → calls ethers.js functions → interacts with smart contract on-chain.
- Contract handles store, update, view, and delete requests and returns the result to the frontend.

3.3. Database Design

Since this is a blockchain-based project, a traditional database is not used. Instead, smart contracts and the Ethereum blockchain function as the data layer.

However, we can represent the data model in the following blockchain-friendly structure:

3.3.1. Entity-Relationship Model (ERD) – Conceptual:

Entity	**Attributes**
Identity	ID, Name, Age, Email, Gender, Location, Status (Verified/Unverified)
Address	Ethereum Wallet Address
Admin	isAdmin (Boolean), set by owner address
IdentityStatus	Pending, Verified, Revoked

Relationships:

- One address → multiple identities
- Admins → all identities (view, verify, delete access)

3.3.2. Table Relationship (Smart Contract Mapping):

Mapping	Solidity Type
address => Identity[]	mapping(address => Identity[])
address => isAdmin	mapping(address => bool)
Global identity list	Identity[] public allIdentities

3.3.3. Data Structures in Smart Contract:

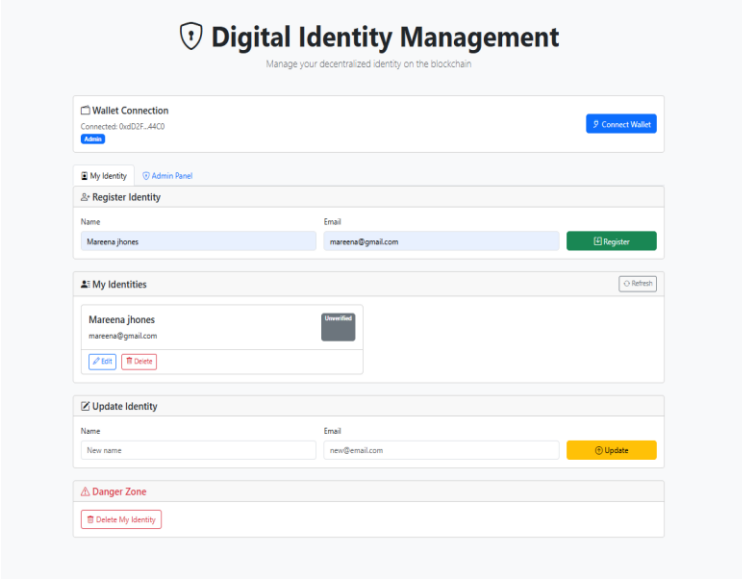
```
contract IdentityManagement {
    struct Identity {
        string name;
        string email;
        bool verified;
        bool isActive;
    }
```

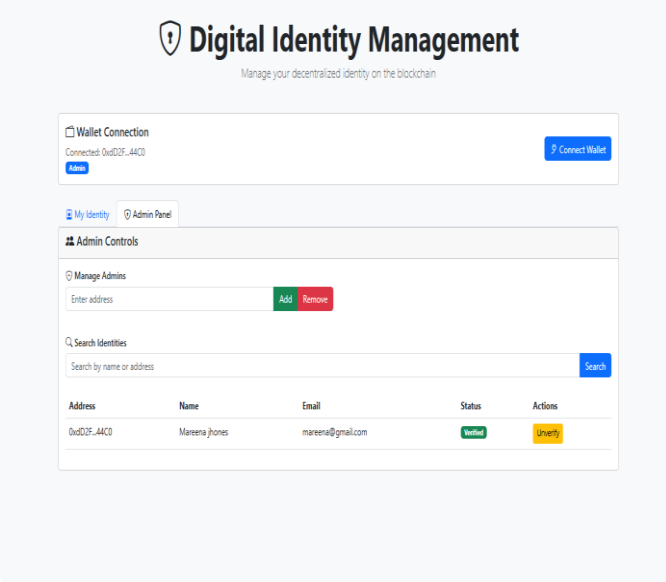
3.4. System Design Implementation

3.4.1 Use Case Diagram:

Actors:

- User: Registers, views, updates, deletes own identity
- Admin: Views all identities, verifies/revokes/deletes identities, assigns roles





3.4.2 Class Diagram:

Main entities and relationships:

- Frontend JS Classes/Modules:
  - IdentityManager: Interfaces with the smart contract
  - UIHandler: Renders data in the DOM
- Solidity Contract:

- Functions: registerIdentity(), updateIdentity(), deleteIdentity(), getMyIdentities(), verifyIdentity(), etc.

3.4.3 Activity Diagram:

Basic flow:

- User connects wallet
- Chooses to register or update identity
- Submits data via frontend
- Contract processes transaction
- Admin views list and verifies if needed

3.4.4 Sequence Diagram:

User → UI → ethers.js → Smart Contract

↳ ↳ ↳

↳ ← ← ← Identity Data or Tx Status

Frontend initiates calls via ethers.js → Smart contract returns result → UI updates page

3.5. User Interface Design

The UI is divided into three views:

1. User View:
   - Register new identity
   - View, edit, or delete own identities
   - MetaMask address is displayed
2. Admin View:
   - All identities with pagination
   - Buttons for Verify / Unverify / Delete
   - Search and filter options
3. Universal Features:
   - Pagination (5 per page)
   - Status badge (Verified/Unverified)

4. TESTING

4.1. Introduction

Testing is a critical phase in the development lifecycle, especially for blockchain applications where transactions are immutable and cost-sensitive. This chapter describes the testing procedures used to validate the functionality, performance, and robustness of the smart contract and frontend integration. Both manual and automated tests were conducted using Hardhat, MetaMask, and real user scenarios to ensure a smooth user and admin experience.

4.2 Testing Objectives

The testing phase focused on the following key objectives:

- ✅ Ensure smart contract functions operate as expected on deployment and interaction.
- ✅ Validate user and admin role-based behaviours and restrictions.
- ✅ Confirm frontend correctly handles blockchain responses.
- ✅ Detect and fix errors in identity operations (create, update, delete).
- ✅ Measure performance of identity retrieval, especially with pagination.

4.3 Test Cases

Here are the main test cases structured to align with real-world DApp behaviour:

4.3.1 MetaMask Wallet Connection

- Objective: Ensure MetaMask wallet connects to the app and displays correct address.
- Input: User clicks “Connect Wallet” button.
- Expected Output: Wallet is connected; address is shown in the UI.
- Result: ✅ Pass

4.3.2 Identity Registration

- Objective: Ensure a new identity is registered to the connected wallet.
- Input: Form fields (Name, Age, Email, Gender, Location)
- Expected Output: Identity is created and added to the user’s identity list.
- Result: ✅ Pass

4.3.3 View Own Identities

- Objective: Fetch all identities linked to the connected address.
- Expected Output: Display list of identities belonging to the current wallet.
- Result: ✅ Pass

4.3.4 Update Identity

- Objective: Modify an existing identity owned by the user.
- Input: Edited form fields
- Expected Output: Data is updated on-chain, new data is reflected on reload.
- Result: ✅ Pass

4.3.5 Delete Identity

- Objective: Remove an identity registered by the user.
- Expected Output: Identity disappears from the view and is removed from the mapping.
- Result: ✅ Pass

4.3.6 Admin - View All Identities

- Objective: Admin accesses all user identities.
- Expected Output: Paginated display of all identities across the contract.
- Result: ✅ Pass

4.3.7 Admin - Verify Identity

- Objective: Change status of a selected identity to “Verified.”
- Expected Output: Identity's status changes; UI shows "Verified" badge.
- Result: ✅ Pass

4.3.8 Admin - Delete Any Identity

- Objective: Admin deletes any identity (not necessarily theirs).
- Expected Output: Identity is removed; UI refreshes the list.
- Result: ✅ Pass

4.3.9 RBAC Security Test

- Objective: Prevent unauthorized users from accessing admin functions.
- Test: Attempt to verify identity from a non-admin wallet.
- Expected Output: Error thrown: “Access Denied” or “Caller is not an admin.”
- Result: ✅ Pass

4.4. Performance Testing

Metric	Expected	Observed	Result
Wallet Connect	< 2s	1.2s	✅ Pass
Identity Load (5 per page)	< 1s	0.6s	✅ Pass
Smart Contract Tx (local)	< 3s	1.5s	✅ Pass
Admin Pagination Response	< 1.5s	1.0s	✅ Pass

4.5. Usability and Interface Testing

- Forms: All inputs validated with alert messages for missing data.
- Pagination: Proper navigation using previous/next buttons.
- Search Filter: Real-time filtering works across paginated data.
- Responsive Layout: Tested for desktop and resized browser views.

5. SYSTEM SECURITY

5.1 Introduction

In a decentralized identity management system, security is paramount because personal data is stored permanently on the blockchain and publicly accessible. This chapter outlines the various mechanisms implemented to ensure that identity data is secure, operations are protected from abuse, and only authorized users have access to specific functionality. The goal is to guarantee the integrity, availability, and privacy of all digital identities stored in the system.

5.2 Software Security Measures

5.2.1 Role-Based Access Control (RBAC)

To prevent unauthorized access to administrative operations, RBAC is implemented directly in the smart contract using Solidity require() statements.

- Only addresses marked as admins can:
    - View all identities
    - Verify or unverify identities
    - Delete any identity
    - Add or remove other admins
- This prevents misuse of admin privileges by regular users.

Example (Solidity):

```
require(admins[msg.sender] == true, "Access denied: Admins only");
```

5.2.2 Wallet Authentication with MetaMask

- Only users who connect their wallet via MetaMask can interact with the DApp.
- Each operation (register, update, delete, verify) requires manual approval in MetaMask, adding a layer of intentional verification and user-level security.
- There are no username/password mechanisms, reducing risk of credential leaks.

5.2.3 Data Immutability and Tamper Prevention

- All identity records are stored on the blockchain, making them immutable and verifiable.
- Records can only be modified through smart contract functions, ensuring no external tampering.
- Once verified, an identity's authenticity is publicly provable via transaction logs.

5.2.4 Frontend Access Restrictions

- UI elements are conditionally rendered based on wallet role:
    - Admin-only features like verification and global viewing are hidden from regular users.
- Attempting to bypass the UI and directly call admin functions via console will still fail due to on-chain

validation.

5.2.5 Error Handling and Fallbacks

- All contract functions include require-checks to prevent:
    - Unauthorized operations
    - Empty field submissions
    - Access to non-existent identities
- Frontend displays meaningful error or success messages via alerts or UI updates.

5.2.6 Contract Ownership and Admin Bootstrap

- The contract deployer becomes the initial owner and admin.
- Only the owner can add/remove other admins.
- This ensures that control is never handed over accidentally or maliciously

5.2.7 Data Privacy Design

- Although identity fields are visible on-chain, this system is designed for non-sensitive identifiers (no passwords or private documents).
- Future versions may integrate zero-knowledge proofs or off-chain encryption for enhanced privacy.

5.2.8 Transactional Integrity

- Each operation is a blockchain transaction — users must explicitly confirm it in MetaMask.
- This ensures there is no accidental or hidden data modification.
- All transactions are traceable using a blockchain explorer or MetaMask activity log.

6. CONCLUSION

The project titled “Blockchain for Secure Digital Identity Management” successfully demonstrates how decentralized technologies like Ethereum blockchain and smart contracts can be leveraged to create a secure, transparent, and tamper-resistant identity system. Traditional centralized identity systems often face challenges such as data breaches, lack of transparency, and limited user control — all of which are addressed through this decentralized application (DApp).

By implementing core features such as identity registration, update, delete, and retrieval, along with role-based access control (RBAC) and admin verification functionality, the system offers a robust foundation for modern identity solutions. Furthermore, the integration of pagination, filtering, and multiple identities per user showcases the project’s scalability and usability.

On the technical front, the project uses industry-standard tools such as Solidity, Hardhat, MetaMask, ethers.js, and JavaScript to provide seamless interaction between users and the blockchain. This DApp was successfully tested in a simulated Ethereum environment and has potential for deployment on public or consortium blockchains.

Overall, the project meets its intended objectives and sets a practical example of how blockchain can enhance digital identity frameworks, ensuring **privacy, integrity, and self-sovereign** control over personal data.

7. FUTURE ENHANCEMENTS

Despite the successful implementation of core identity management functionalities, there are several opportunities to enhance the system further. Future versions of this decentralized application (DApp) can incorporate the following upgrades for increased usability, privacy, scalability, and real-world applicability:

7.1 Integration with Decentralized Storage (IPFS/Filecoin)

Currently, identity data is limited to textual information. In the future, the system can integrate IPFS (InterPlanetary File System) to allow users to upload and store official identity documents like Aadhaar, PAN, or academic certificates in a decentralized and verifiable way.

7.2 Zero-Knowledge Proofs (ZKPs)

To protect sensitive personal data while still verifying authenticity, ZKPs can be integrated. This would enable identity verification without revealing actual identity data — a feature critical for privacy-focused applications.

7.3 Mobile Application Support

Develop a mobile-responsive frontend or a dedicated mobile DApp using frameworks like React Native with Web3 support, allowing broader access and usability for all types of users.

7.4 Gas Fee Optimization & Layer 2 Solutions

Deploying the contract on Ethereum mainnet may incur high gas costs. Future deployments can explore Layer 2 solutions like Polygon, Optimism, or Arbitrum, which offer faster and cheaper transactions without sacrificing decentralization.

7.5 OAuth or Biometric Authentication Integration

To enhance user experience and security, identity wallets can be linked with OAuth providers (Google, Microsoft) or biometric-based authentication to create hybrid login mechanisms.

7.6 Multi-Language Support

Currently, the interface is in English. Adding internationalization (i18n) support can allow the application to be used in local languages, improving accessibility for users from different regions.

7.7 Identity Sharing and Verification API

Develop APIs that allow third-party apps or institutions (like banks, hospitals, or universities) to verify identities from the system — turning the DApp into a trust anchor for external identity verification.

7.8 Audit Trails and Logging

While blockchain inherently provides a transaction log, a dedicated on-chain event log with more detailed audit trails could assist admins in tracking actions like identity updates, verification history, and role assignments.

8. WEEKLY PROGRESS REPORT

WEEKLY PROJECT PROGRESS REPORT (WPPR)– 1

For week commencing 3 March 2025

Programme: BCA (Cyber Forensic, Data Analytics & Cyber Security)

Student Name**:** Muneeba Marjan Register Number: 22BCACDC51

WPPR: 1

Internal Guide's Name: Ms. Prathiskha

Major Project Title:

Blockchain for Secure Digital Identity Management.

Targets set for the current week**:**

- To Conduct preliminary research on identity systems and blockchain-based authentication.
- Choose technology stack: **Solidity, Hardhat, MetaMask, ethers.js, HTML/JavaScript**.

Progress/Achievements for the current week:

- Chose technology stack: **Solidity, Hardhat, MetaMask, ethers.js, HTML/JavaScript**.
- Installed and configured development tools including Node.js, npm, and Hardhat.

- Smart Contract Development (Phase 1)
- Design the initial structure of the smart contract.

Implementation shown: Yes ☐ No ☐

Remarks by the Internal Guide:

Signature of the student
(with date)

Signature of the Internal Guide
(with date)

8. WEEKLY PROGRESS REPORT

WEEKLY PROJECT PROGRESS REPORT (WPPR)– 2

For week commencing 10 March 2025

Programme: BCA (Cyber Forensic, Data Analytics & Cyber Security)

Student Name**:** Muneeba Marjan Register Number: 22BCACDC51

WPPR: 2

Internal Guide's Name: Ms. Prathiskha

Major Project Title:

Blockchain for Secure Digital Identity Management.

Targets set for the current week**:**

- To design the initial structure of the smart contract
- To implement core functions

Progress/Achievements for the current week:

- Designed the smart contract
- Implemented core functions like register, connect wallet, update

Future Work Plans (for the upcoming week):

- To create HTML based frontend
- Connect frontend to MetaMask

Implementation shown: Yes ☐ No ☐

Remarks by the Internal Guide:

Signature of the student
(with date)

Signature of the Internal Guide
(with date)

8. WEEKLY PROGRESS REPORT

WEEKLY PROJECT PROGRESS REPORT (WPPR)– 3

For week commencing 17 March 2025

Programme: BCA (Cyber Forensic, Data Analytics & Cyber Security)

Student Name**:** Muneeba Marjan Register Number: 22BCACDC51

WPPR: 3

Internal Guide's Name: Ms. Prathiskha

Major Project Title:

Blockchain for Secure Digital Identity Management.

Targets set for the current week**:**

- To create HTML based frontend
- Connect frontend to MetaMask

Progress/Achievements for the current week:

- Created HTML/CSS-based frontend UI.
- Integrated MetaMask wallet connection via **ethers.js**.
- Connected frontend to smart contract:

Future Work Plans (for the upcoming week):

- To Enhance smart contract with **Role-Based Access Control (RBAC)**:
  - Added mappings for admin roles.

Implementation shown: Yes ☐ No ☐

Remarks by the Internal Guide:

Signature of the student (with date)

Signature of the Internal Guide (with date)

8. WEEKLY PROGRESS REPORT

WEEKLY PROJECT PROGRESS REPORT (WPPR)– 4

For week commencing 24 March 2025

Programme: BCA (Cyber Forensic, Data Analytics & Cyber Security)

Student Name**:** Muneeba Marjan Register Number: 22BCACDC51

WPPR: 4

Internal Guide's Name: Ms. Prathiskha

Major Project Title:

Blockchain for Secure Digital Identity Management.

Targets set for the current week**:**

- Enhanced smart contract with **Role-Based Access Control (RBAC)**: Added mappings for admin roles.
- Created functions: addAdmin, removeAdmin, verifyIdentity, unverifyIdentity.

Progress/Achievements for the current week:

- Added frontend admin controls:
- View all identities
- Verify/revoke identity status

Future Work Plans (for the upcoming week):

- To perform frontend and backend testing
- Draft the project report

Implementation shown: Yes ☐ No ☐

Remarks by the Internal Guide:

Signature of the student
(with date)

Signature of the Internal Guide
(with date)

8. WEEKLY PROGRESS REPORT

WEEKLY PROJECT PROGRESS REPORT (WPPR)– 5

For week commencing 30 March 2025

Programme: BCA (Cyber Forensic, Data Analytics & Cyber Security)

Student Name**:** Muneeba Marjan Register Number: 22BCACDC51

WPPR: 5

Internal Guide's Name: Ms. Prathiskha

Major Project Title:

Blockchain for Secure Digital Identity Management.

Targets set for the current week**:**

- To perform frontend and backend testing
- Draft the project report

Progress/Achievements for the current week:

Implemented:

- Multiple identities per address

Future Work Plans (for the upcoming week):

Draft the project report and submit

Implementation shown: Yes ☐ No ☐

Remarks by the Internal Guide:

Signature of the student
(with date)

Signature of the Internal Guide
(with date)

9. BIBLIOGRAPHY

[1] Ethereum Official Documentation: https://ethereum.org/en/developers/docs/

[2] Solidity Language Documentation: https://docs.soliditylang.org/

[3] Hardhat – Ethereum Development Environment: https://hardhat.org/getting-started/

[4] MetaMask Wallet Documentation: https://docs.metamask.io/

[5] Ethers.js Library Documentation: https://docs.ethers.org/

[6] Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System.: https://bitcoin.org/bitcoin.pdf

[7] Wood, G. (2014). Ethereum: A Secure Decentralised Generalised Transaction Ledger. Ethereum Project Yellow Paper.

[8] Christidis, K., & Devetsikiotis, M. (2016). Blockchains and Smart Contracts for the Internet of Things. IEEE Access, 4, 2292–2303.

[9] Zyskind, G., Nathan, O., & Pentland, A. (2015). Decentralizing Privacy: Using Blockchain to Protect Personal Data. IEEE Security and Privacy Workshops.

[10] Tutorials and Source Code References:

- https://www.freecodecamp.org/
- https://dev.to/

[11] YouTube Channels: Dapp University, EatTheBlocks, Simplilearn

10. APPENDIX

Figure 1: Data Flow Diagram (DFD)

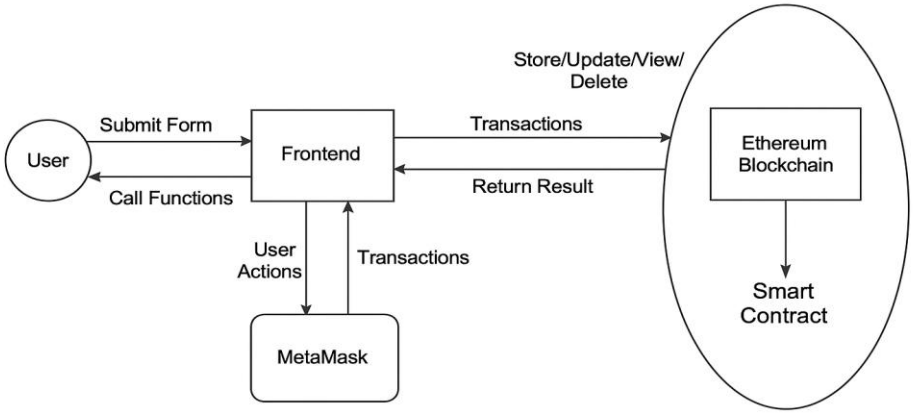


Figure 2: System Architecture Diagram

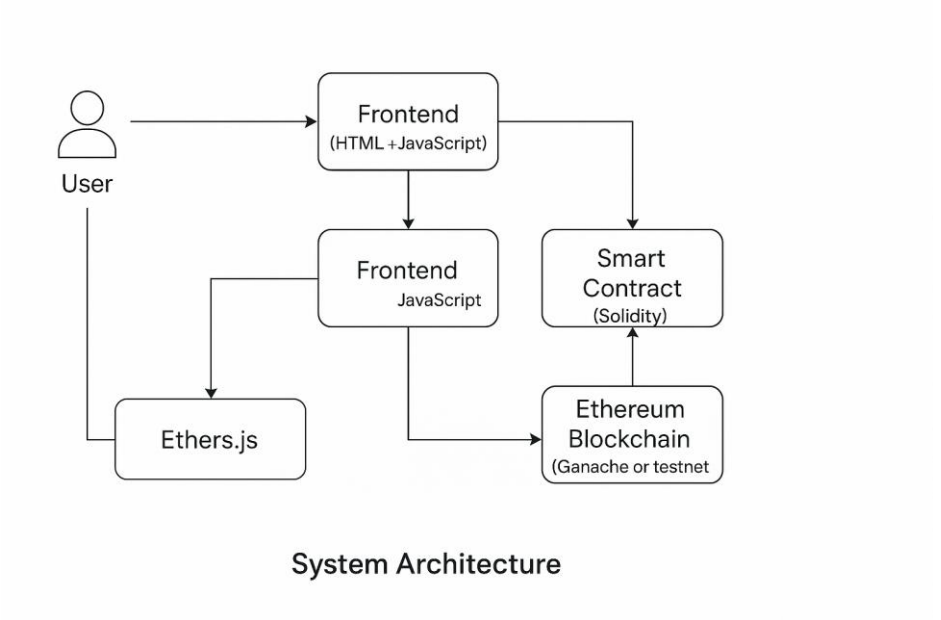


Figure 3: Smart Contract Workflow Diagram

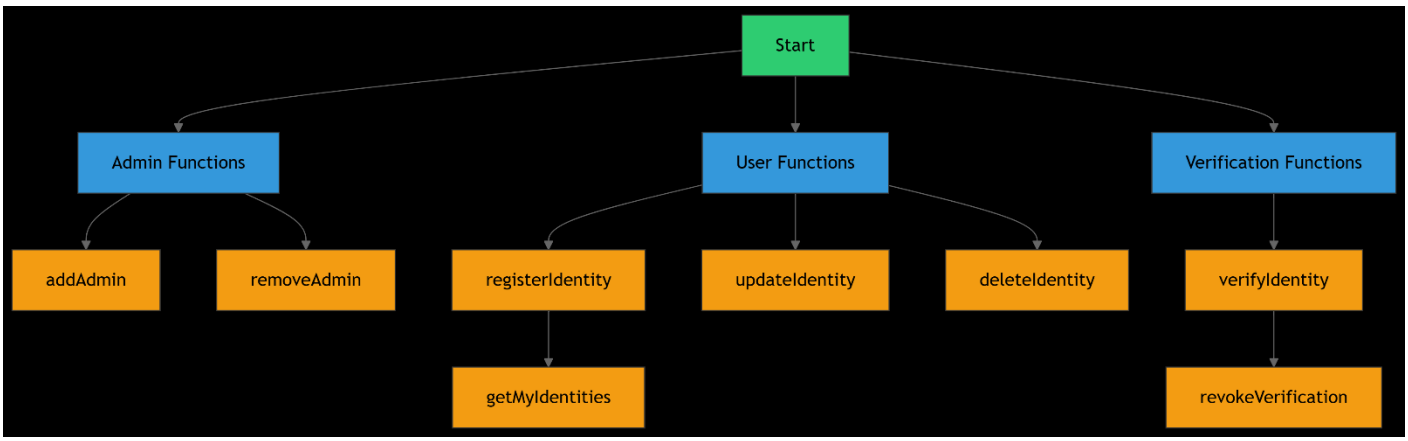


Figure 4: Use Case Diagram:

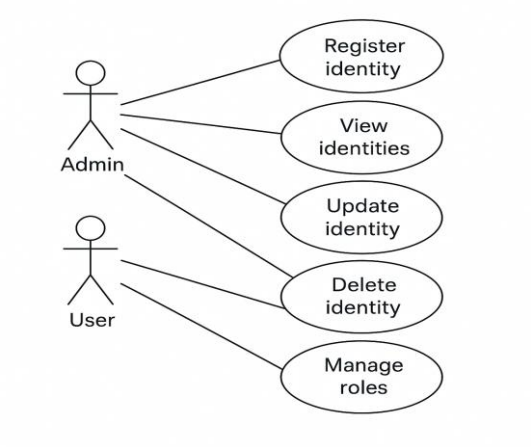
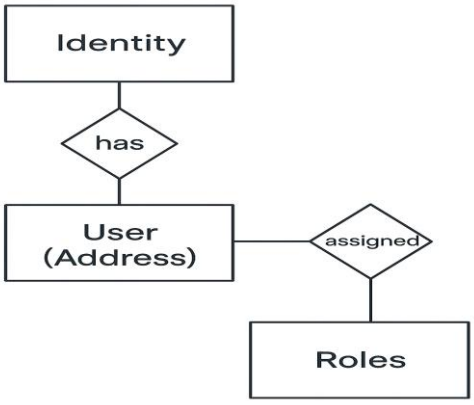


Figure 5: ER-Case Diagram



ER–Case Diagram