

Decentralized Intellectual Property (IP) Protection Platform with AI-Powered Similarity Detection

R25-016

Project Proposal Report

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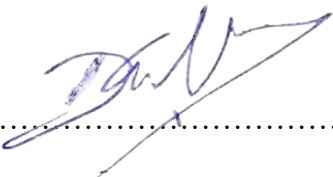
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DECLARATION

I declare that this is my own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

The increasing prevalence of digitalization necessitates a robust solution to intellectual property (IP) protection, addressing issues such as plagiarism, unauthorized usage, and inefficiencies in centralized systems. This proposal integrates blockchain technology to develop a decentralized platform for secure IP registration, ownership verification, and infringement detection.

Blockchain provides immutable and tamper-proof IP registration through smart contracts, ensuring automated, transparent, and auditable transactions. Key technologies like Solidity and OpenZeppelin are employed for smart contract creation, while Hardhat and Alchemy facilitate development and blockchain interaction. Wallet integration using MetaMask and user authentication via Moralis enhance usability and security.

The solution extends its utility to academic research, creative industries, technology innovation, and publishing by converting IP assets into NFTs, managed through platforms like OpenSea.

This integration enables traceable and secure IP tokenization. The proposed system uses Etherscan for transaction monitoring and incorporates tools like CoinMarketCap for cryptocurrency data integration.

This blockchain-powered framework addresses limitations of traditional IP systems by introducing a scalable, decentralized approach, fostering transparency, ownership security, and real-time IP management. The platform's innovative use of blockchain creates a groundbreaking IP protection mechanism tailored to meet the demands of the modern digital economy.

Keywords: Blockchain, IP Protection, Smart Contracts, Decentralized Systems, NFTs, Transparency.

TABLE OF CONTENTS

Declaration	iii
ABSTRACT.....	iv
List of Figures	vii
List of tables.....	viii
1. INTRODUCTION	1
2. Background & Literature Survey	2
3. Research Gap	3
4. Research Problem	4
5. OBJECTIVES	5
5.1 Main Objective.....	5
5.2 Specific Objectives	5
6. METHODOLOGY	6
6.1 System Architecture diagram.....	6
6.2 The flow of the project.....	7
6.2.1. Requirement Gathering and Analysis	7
6.2.2. Feasibility Study	7
6.2.3. Implementation	8
6.2.4. Testing.....	9
7. Project Requirements	9
7.1 Functional and Non-Functional Requirements	9
7.2 Software Requirements	10
8. GANTT CHART	12
9. COMERCIALIZATION	13

10.	REFERENCES	14
11.	APPENDICES	16
11.1	Plagiarism report.....	16

LIST OF FIGURES

Figure 1: System architecture diagram	6
Figure 2: Grant Chart	12
Figure 3: Plagiarism Report	16

LIST OF TABLES

Table 1: Functional and Non-Functional Requirements	9
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1. INTRODUCTION

In the rapidly evolving digital landscape, the protection of Intellectual Property (IP) has become increasingly complex and challenging. Traditional IP protection systems, which rely heavily on centralized databases and manual processes, often fall short in addressing critical issues such as data tampering, unauthorized access, inefficient registration procedures, and delayed infringement detection. These limitations not only hinder innovation but also pose significant risks to creators, businesses, and legal entities in safeguarding their intellectual assets.

The advent of blockchain technology offers transformative potential for overcoming these challenges. With its decentralized, transparent, and immutable ledger, blockchain ensures secure IP registration, verifiable ownership, and auditable transactions without the need for intermediaries. Furthermore, integrating Artificial Intelligence (AI) into IP management enhances the system's capability to detect infringements through advanced similarity detection techniques for text, images, and multimedia content.

This proposal presents a **Decentralized Intellectual Property (IP) Protection Platform with AI-Powered Similarity Detection**, designed to revolutionize the way IP is managed, protected, and commercialized. The platform leverages blockchain technologies such as **Solidity**, **OpenZeppelin**, **Hardhat**, and **Alchemy** for smart contract deployment and blockchain interaction. Additionally, tools like **MetaMask** and **Moralis** are integrated for secure user authentication and wallet management, while **OpenSea** facilitates IP asset tokenization as Non-Fungible Tokens (NFTs).

The system also incorporates advanced AI/ML models for real-time infringement detection, enabling proactive identification of potential IP violations. This fusion of blockchain and AI technologies not only ensures tamper-proof registration and ownership verification but also introduces scalability, transparency, and efficiency into IP management processes.

By addressing the inherent vulnerabilities of traditional IP systems, this research aims to develop a comprehensive, decentralized framework that supports secure IP registration, automated licensing, real-time monitoring, and seamless commercialization of intellectual assets.

2. BACKGROUND & LITERATURE SURVEY

The protection of intellectual property (IP) has always been a cornerstone for fostering innovation and creativity. Traditional IP protection systems rely heavily on centralized databases and manual processes, which often make them prone to inefficiencies such as latency in registration, unauthorized access, and susceptibility to tampering. Blockchain technology, with its decentralized and immutable ledger, has emerged as a promising solution to these challenges.

Existing literature emphasizes blockchain's capabilities in ensuring secure, traceable transactions and immutable record-keeping. For example, platforms like Ethereum leverage smart contracts to automate and authenticate transactions, while marketplaces such as OpenSea tokenize assets into Non-Fungible Tokens (NFTs), facilitating traceable ownership transfers. However, despite these advancements, integration of blockchain with other technologies like Artificial Intelligence (AI) for advanced features such as IP similarity detection remains underexplored.

Recent studies also highlight tools such as Moralis for blockchain authentication and MetaMask for wallet integration, which simplify user interactions in blockchain systems. These innovations have demonstrated potential in improving user experience and system scalability, laying the groundwork for integrating blockchain in IP protection.

3. RESEARCH GAP

Despite advancements in blockchain and its integration into IP protection, several gaps remain. Traditional systems suffer from challenges such as:

Lack of Real-time Detection: Current systems rarely integrate AI/ML for real-time similarity detection, limiting their capability to identify infringements effectively.

Scalability Issues: Blockchain adoption in IP management has been limited to niche areas like NFT creation, with no comprehensive solutions that address scalability for global IP registries.

Contextual Patent Discovery: Existing systems lack robust mechanisms for identifying related innovations, impeding research collaborations and innovation growth.

Transparency & Usability: Many solutions are overly complex for non-technical users, limiting widespread adoption.

These gaps underline the need for a unified, decentralized system that integrates blockchain and AI to address these limitations comprehensively.

4. RESEARCH PROBLEM

The core research problem revolves around developing a blockchain-powered decentralized platform that addresses inefficiencies in traditional IP protection. The platform must combine blockchain's transparency and immutability with AI/ML's capability for real-time similarity detection and contextual patent discovery. This will not only provide secure and tamper-proof IP registration but also offer real-time insights into potential infringements.

The proposed solution aims to tackle the following issues:

- Ensuring tamper-proof ownership and licensing of IP through automated smart contracts.
- Incorporating AI for advanced similarity detection of text, images, and multimedia content.
- Addressing scalability by leveraging decentralized architecture for global accessibility.
- Enhancing user experience through intuitive interfaces and streamlined integration with tools like MetaMask and Moralis.
- This research seeks to bridge the gap between technological capabilities and the demands of modern IP protection, fostering innovation and addressing the vulnerabilities of existing systems.

5. OBJECTIVES

5.1 Main Objective

To develop a decentralized platform that integrates blockchain and artificial intelligence for robust intellectual property (IP) protection, enabling tamper-proof registration, automated licensing, real-time infringement detection, and enhanced user accessibility.

5.2 Specific Objectives

- (1) Secure IP Registration and Ownership Verification
 - (a) Utilize blockchain technology to create a decentralized IP registry with immutable records.
 - (b) Implement smart contracts using Solidity and OpenZeppelin for automated ownership verification and licensing.
- (2) Real-time Infringement Detection
 - (a) Develop AI/ML models for detecting similarities in text, images, and multimedia content.
 - (b) Implement algorithms for real-time analysis of infringements using advanced NLP and multimedia comparison techniques.
- (3) Scalable and Transparent IP Marketplace
 - (a) Design and integrate an IP marketplace to facilitate secure licensing and ownership transfer of IP assets as NFTs using platforms like OpenSea.
 - (b) Leverage blockchain solutions such as Hardhat, Moralis, and Alchemy to enable seamless scalability.
- (4) Contextual Patent and Innovation Discovery
 - (a) Implement semantic search algorithms for discovering related patents and innovations to support research and collaboration.
 - (b) Develop APIs for integrating external datasets and facilitating discovery of tangentially connected IPs.
- (5) User-friendly Interface and Wallet Integration

- (a) Enhance user experience by integrating wallet solutions like MetaMask and wagmi for secure blockchain operations.
- (b) Simplify user authentication and access using Moralis for streamlined identity verification.
- (6) Enhanced Data Visibility and Monitoring
 - (a) Integrate tools like Etherscan and CoinMarketCap for transaction tracking and cryptocurrency data visualization.
 - (b) Provide transparent and auditable operations for all stakeholders.

These objectives align with the identified gaps and research problem, ensuring a comprehensive approach to addressing the inefficiencies and vulnerabilities of traditional IP protection systems.

6. METHODOLOGY

6.1 System Architecture diagram

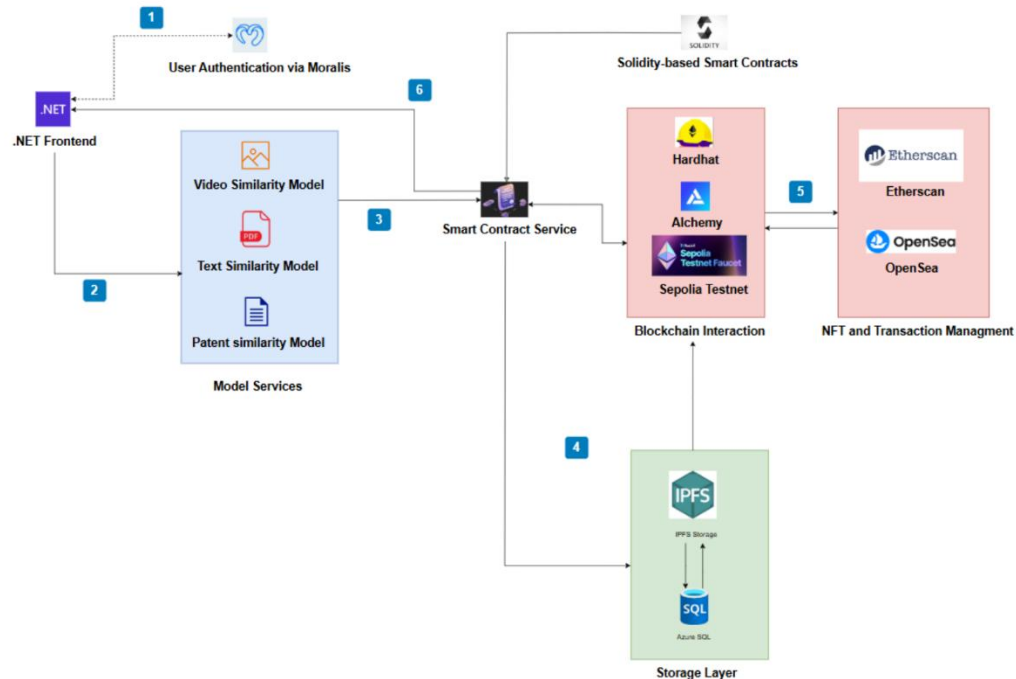


Figure 1: System architecture diagram

6.2 The flow of the project

The development of the decentralized IP protection platform is structured into four major phases: requirement gathering and analysis, feasibility study, implementation, and testing. Each phase contributes significantly to the overall success of the project by ensuring that the system is well-designed, practical, and meets the expectations of all stakeholders.

6.2.1. Requirement Gathering and Analysis

This phase involves collecting, validating, and documenting the requirements necessary to build the platform. The process begins with stakeholder identification, including IP owners, legal professionals, and technology partners. These stakeholders provide insights into the current challenges and expectations from an IP protection system.

- Activities in this phase include:
 - Stakeholder Interviews: Understand specific requirements, such as secure IP registration, licensing, and infringement detection.
 - Surveys and Questionnaires: Gather broader feedback on existing IP protection challenges.
 - Document Analysis: Study intellectual property laws and blockchain protocols to align the platform with global standards.
 - Market Research: Analyze current IP protection solutions and blockchain platforms to identify gaps and opportunities.
- Key Outcomes:
 - A comprehensive requirement specification document.
 - Identification of functional and non-functional requirements, ensuring alignment with user needs. Initial system design concepts based on requirements.

6.2.2. Feasibility Study

The feasibility study evaluates the practicality of the proposed platform, considering technical, economic, and operational factors. The goal is to determine whether the project can be successfully developed and deployed within the constraints of resources, time, and technology

- **Technical Feasibility:**
 - Assess blockchain technology's capability to handle decentralized IP registration.
 - Evaluate the integration of AI/ML for real-time infringement detection.
 - Analyze scalability with tools like Hardhat, Moralis, and MetaMask.
- **Operational Feasibility:**
 - Ensure ease of adoption by stakeholders, focusing on usability and transparency.
 - Validate compliance with legal standards for IP protection.
- **Economic Feasibility:**
 - Estimate development costs, including software licensing and infrastructure.
 - Calculate potential ROI based on market demand for IP protection.

6.2.3. Implementation

The implementation phase involves the actual development of the platform. This phase is carried out in modular stages to ensure systematic integration and testing of components.

- **System Design:**
 - Finalize architecture, defining interactions between frontend, smart contracts, and blockchain services.
- **Frontend Development:**
 - Build the user interface using .NET MVC, integrating Moralis for authentication and MetaMask for wallet operations.
- **Backend Development:**
 - Develop smart contracts with Solidity and OpenZeppelin templates for secure IP registration.
 - Deploy contracts on the blockchain using Hardhat and Alchemy.
- **Blockchain Integration:**
 - Enable real-time transactions and monitoring via Etherscan.
 - Integrate NFT tokenization for IP assets using OpenSea.

6.2.4. Testing

- Unit Testing:
 - Validate the functionality of smart contracts, wallet integrations, and APIs.
- Integration Testing:
 - Ensure seamless interaction between components, such as frontend, backend, and blockchain services.
- Performance Testing:
 - Assess the scalability of the platform under high user loads.
 - Measure response times for blockchain operations and smart contract execution.
- User Acceptance Testing (UAT):
 - Collaborate with stakeholders to validate usability and functionality.
 - Gather feedback for further refinement.

7. PROJECT REQUIREMENTS

The success of the decentralized IP protection platform depends on defining comprehensive requirements to guide its development. These requirements encompass functional, non-functional, and software aspects, ensuring that the system is robust, efficient, and user-friendly.

7.1 Functional and Non-Functional Requirements

Table 1: Functional and Non-Functional Requirements

Category	Requirement	Description
Functional Requirements	Secure IP Registration	Allow users to register intellectual property with immutable records on the blockchain.
	Automated Smart Contracts	Use Solidity-based smart contracts for ownership verification, licensing, and IP transfers.
	Real-time Infringement Detection	Implement AI/ML models to identify text, image, and multimedia similarities.

	NFT Creation and Management	Convert registered IP assets into NFTs and facilitate trading through OpenSea.
	Wallet Integration	Enable secure user authentication and transactions through MetaMask and Moralis.
	Transaction Monitoring	Use Etherscan to provide a transparent view of all blockchain operations.
Non-Functional Requirements	Scalability	Support a growing number of users and transactions across global jurisdictions.
	Performance	Maintain efficient response times for real-time transactions and similarity detection.
	Security	Ensure data integrity and secure authentication using robust encryption and blockchain immutability.
	Reliability	Maintain high availability and minimal downtime for uninterrupted user access.
	Usability	Provide an intuitive and accessible interface for technical and non-technical users.
	Interoperability	Ensure smooth integration with tools like OpenSea, Etherscan, and CoinMarketCap.

7.2 Software Requirements

The software requirements specify the tools, platforms, and frameworks needed to develop and deploy the platform:

- Frontend:
 - .NET MVC framework for user interface development.
- Backend:
 - Solidity for smart contract creation.
 - OpenZeppelin templates for secure smart contracts.

- Blockchain Integration:
 - Hardhat for development and testing.
 - Alchemy for blockchain API services.
- NFT Management:
 - Integration with OpenSea for IP tokenization.
- Wallet and Authentication:
 - MetaMask for transactions and Moralis for user authentication.
- Monitoring Tools:
 - Etherscan for transaction tracking and CoinMarketCap for cryptocurrency data.

8. GANTT CHART

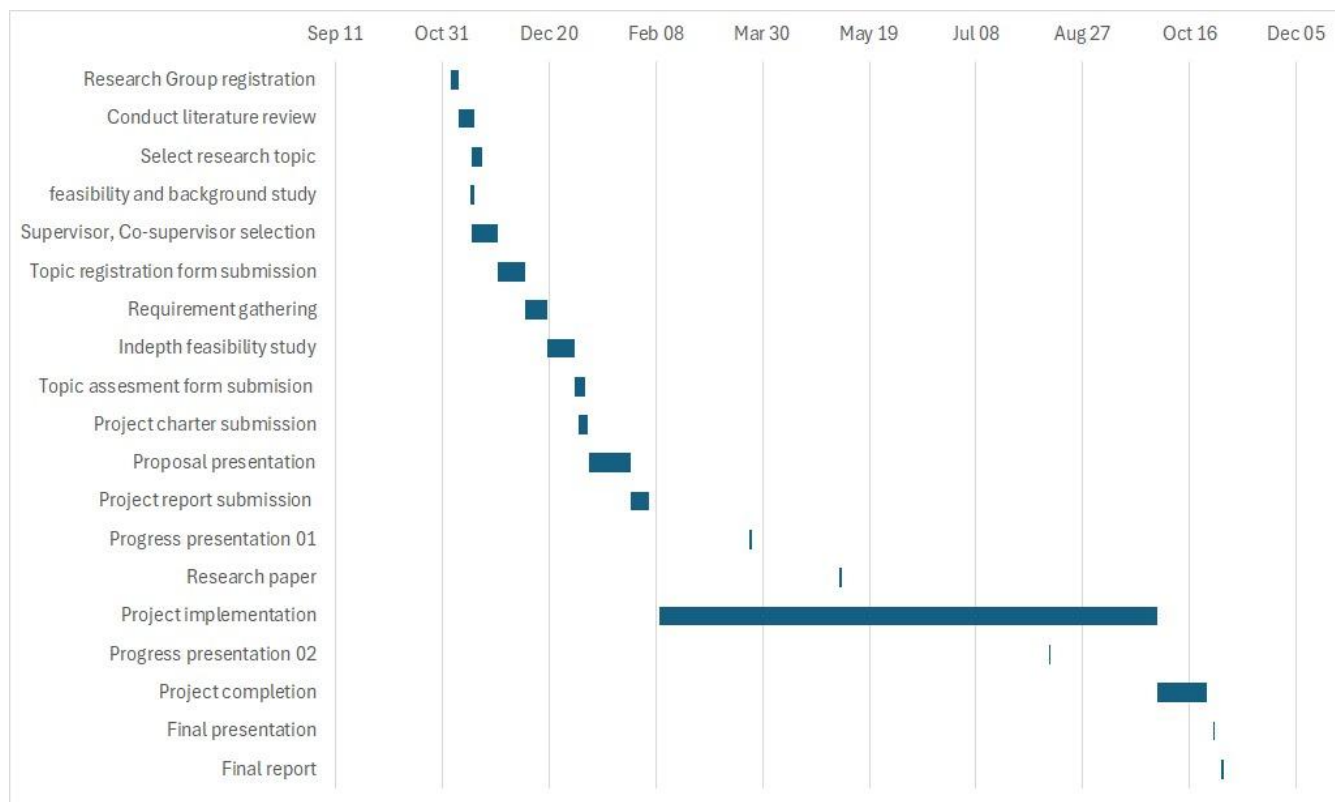


Figure 2: Grant Chart

9. COMERCIALIZATION

The commercialization plan for the Decentralized IP Protection Platform is initiated with a strategic 30-day free trial, allowing potential users—including researchers, artists, publishers, and organizations—to evaluate its capabilities and impact on safeguarding intellectual property (IP). The initial target market includes these stakeholders and legal professionals, with a series of tailored promotional campaigns planned to capture their interest. These campaigns will emphasize the platform's ability to provide secure, tamper-proof IP registration, automated licensing, and real-time infringement detection. Throughout the trial period, feedback will be gathered to refine the system and address user-specific requirements.

The pricing strategy is designed with multiple tiers to accommodate diverse user needs and organizational sizes:

- Basic Plan:
 - Designed for individuals or small-scale IP owners, this plan offers essential features such as blockchain-based IP registration and monitoring at an affordable subscription fee, suitable for minimal usage.
- Standard Plan:
 - Targeted at mid-sized entities, including academic institutions or creative agencies, this plan provides a comprehensive suite of tools, including NFT creation, real-time infringement detection, and licensing capabilities, with higher usage quotas at a competitive price.
- Premium Plan:
 - Ideal for large-scale organizations and businesses with extensive IP portfolios, this plan includes unlimited access to all platform features, priority support, and advanced analytics.
- Enterprise Plan:
 - Tailored for large enterprises or legal consortia, this customizable plan offers dedicated support, bespoke integrations, and specialized features based on detailed consultations, with pricing structured to meet specific institutional needs.

To boost adoption rates, early bird discounts and special incentives will be offered to first-time users, long-term subscribers, and bulk buyers. Promotional pricing will also be introduced during industry events, blockchain conferences, and educational workshops to extend the platform's visibility and accessibility. Partnerships with academic institutions, creative industries, and government bodies will be cultivated to accelerate market penetration and establish the platform as a leading solution for decentralized IP protection.

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11. APPENDICES

11.1 Plagiarism report



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Figure 3: Plagiarism Report