A Scalable Framework for Game Transformation and Metaverse Financing

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Abstract

This report examines a blockchain-based gaming project that employs a governance token and a DAO to drive stakeholder engagement and equitable resource distribution. The project uses Next.js and Express.js for its frontend and API, with the Solana blockchain supporting backend operations. A key feature is the integration of a governance model that rewards participants with tokens, enabling a sustainable and community-driven ecosystem. Future enhancements will focus on establishing a decentralized exchange to improve asset trading efficiency and security, promoting a more robust and participatory gaming market.

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Abbreviations

AXS	Axie Infinity Shards
API	Application Programming Interface
CRUD	Create, read, update, delete operations
DAO	Decentralized autonomous orrganizations
DeFi	Decentralized finance
DEX	Decentralized exchange
EA	Electronic Arts
ETH	Token symbol for the native token on Ethereum
ERC	Ethereum Request for Comment
FUT	FIFA Ultimate Team
GameFi	Game finance
HKEX	Hong Kong Exchange
ICO	Initial coin offering
IPO	Initial public offering
NFT	Non-fungible token
NYSE	New York Stock Exchange
POC	Proof of concept
POH	Proof of history
P2E	Play-to-earn
RESTful	Representational state transfer
SHIB	Token symbol for Shiba Inu coin
SLP	Smooth Love Portion
SOL	Token symbol for the native token on Solana
SPL	The associate token standard in Solana
UI	User interface
USDT	Token symbol for Tether USD

1. Introduction

The advent of blockchain technology is reshaping the global financial landscape through offering a wide spectrum of alternative investments, including but not limited to cryptocurrencies, associated tokens[1], and NFTs. Associated tokens and NFTs have emerged as a prominent feature of blockchain based transactions, allowing customized tokens and unique digital assets to be transferred and owned securely on respective blockchain ecosystems. This lays the foundation for P2E ecosystems in blockchain gaming. P2E game providers develop their associated tokens and/or NFTs over such networks, distributing them to gamers to represent rights of game utilities according to designated game rules. Gamers could trade them publicly for designated cryptocurrencies. Low-income and unemployed individuals can even secure everyday essentials with gaming [1].

The aggregate market volume of gaming industries is projected to reach USD 321 billion by 2026 [2], of which most revenue generated is derived from real-time multiplayer online games with a primary market-based business model. These game providers realize profits by selling in-game utilities to gamers with fiat currency. A vital limitation of such is the non-transferability of the in-game utilities purchased. The absence of a comprehensive secondary market obstructs return realization and hinders GameFi development, as if traders could only subscribe shares from IPOs but there are no public exchanges, e.g., NYSE or HKEX. Meanwhile, a few well-known game providers offering in-game exchanges, e.g., FIFA series powered by Electronic Arts (EA) Sports, charge in-game credits as transaction fees. However, the collected amounts hold no intrinsic value to game providers[2]. It hinders potential

[1] Associated tokens refer to tokens that are associated to existing networks, e.g., USDT (associated in multiple networks) and SHIB on Ethereum, in contrast to native tokens, such as ETH and SOL.

[2] Game providers burn transaction fees to reduce circulating supply of the native game currency to encourage future purchase.

profitability from opening the market for public transactions that attract market participants [3]. A public exchange for in-game utilities is therefore critical for the broader gaming community to turn in-game utilities asset-like. Associated tokens and NFT-based ecosystem perfectly match the context and serve as the technical foundation for the required enhancement.

Though opening the market brings business potential with the paradigm shift of the gaming providers to Web 3.0 is gaining momentum, it lacks clear incentives and methodologies for initialization. This is because the ongoing evolution of the well-established gaming industry introduces additional business risks and technical obstacles in transforming gaming ecosystems. Therefore, this project is proposing a well-defined framework for game providers and developers to accomplish arisen software engineering requirements methodologically integrated with a motivational tokenomic ecosystem to incentivize them making the transition. This assures providers that they can seamlessly connect their ecosystems to the broader secondary exchange provided with a smooth game transformation to Web 3.0. Meanwhile, this encourages gamers' participation with the public exchange. In addition, the consolidated solution could serve the financial ground of projects considered prodigal, e.g., Metaverse-related developments. The key objectives of the project are as follows.

[Objective 1.] This project will be delivering a tokenomic framework with in-depth industry research conducted as a POC. The framework will critically address and offer the economic incentives required for game providers to perform a paradigm shift to a Web 3.0 based ecosystem.

[Objective 2.] This project be introducing a UI for gamers and an API for software developers to connect the secondary exchange experientially and programmatically respectively.

2. Methodology

To achieve the key objectives of this project, four milestones must be reached. This includes industry research (Section 2.1), formulation of tokenomics (Section 2.2), and POC software development (Section 2.3).

2.1. Industry Research

Extensive research on the gaming industry, blockchain technology, tokenomics, and GameFi was conducted. Both primary and secondary sources were leveraged to gather data and insights. Two case studies were conducted to deepen understanding of business models in both blockchain and traditional gaming. A comparative analysis was performed based on the business models of the selected cases.

Axie Infinity, and FIFA video game series, were selected to be the subjects of the two case studies respectively. The selected cases are of crucial market significance in the gaming industry. Axie has generated over $1.5 billion in NFT trading volume by allowing players to truly own in-game asset NFTs and monetize them through decentralized exchanges [4]; FIFA soccer video game series profits over $1 billion annually from in-game purchases and packs [5]; Annual reports and financial filings from these game providers were analyzed to evaluate the quantitative economic relationship between primary sales revenues and secondary sales revenues (i.e., transaction fees of in-game utilities). The possible obstacles that might be encountered by FIFA during transforming and incorporating an NFT-based exchange to the game were discussed.

2.2. Formulation of Tokenomics

Using the research findings, token economic models tailored for the gaming industry are being formulated. Both transaction and governance tokens are being designed with

associated incentive structures to enable sustainable growth and value creation in blockchain gaming [6]. Different token minting and distribution strategies are being evaluated. The optimal mix depends on balancing incentives for different network participants like game providers, developers, gamers, and investors. Revenue maximization concepts from game theory are being applied to optimize pricing of trading assets [7]. Data is being synthesized from empirical studies on consumer demand elasticity in digital economies.

2.3. POC Software Development

A POC will be developed to demonstrate the proposed tokenomics and allow users to interact with the NFT gaming ecosystem. The POC will consist of a frontend application, backend API, and smart contracts on the blockchain.

The frontend is built using Next.js, a React-based framework that enables server-side rendering and static site generation for optimal page performance [8]. Next.js supports interactive UIs and clean component architecture suitable for the game marketplace and exchange.

The backend API follows a Representational State Transfer (RESTful) design pattern using Node.js and Express. This enables a scalable and organized interface for CRUD operations and endpoints like user authentication, NFT data, and transaction requests [9]. RESTful framework organizes endpoints into logical resources while keeping APIs fast and lightweight.

Solana is eventually chosen as the blockchain network used in this project. Choosing Solana over Ethereum can be justified by several compelling reasons. Firstly, Solana's performance and scalability are superior, with the ability to handle up to 65,000 TPS compared to Ethereum's 30 TPS [10, 11]. This makes it ideal for this project as it demands high transaction

volumes and low latency. Additionally, Solana offers significantly lower transaction costs, which is beneficial for applications involving frequent microtransactions, enhancing cost efficiency for users [10, 11]. The Solana ecosystem is also rapidly growing, providing a robust environment for developers with an increasing number of decentralized applications and innovative tools. Moreover, Solana's unique POH[3] consensus mechanism adds an extra layer of security and efficiency by verifying the time and sequence of events, which is particularly advantageous for projects requiring stringent trust and security measures [10]. These features collectively make Solana a highly attractive platform for developing cutting-edge applications, especially in fields like decentralized finance, gaming, and real-time services. This project adopts the SPL-token standard[4] to create associate tokens.

3. Result and Implementation

This section includes the empirical analysis of the case studies conducted on Axie Infinity and FIFA series (Section 3.1), the proposed tokenomic framework (Section 3.2), and the developed software architecture (Section 3.3).

3.1. Empirical Analysis of the Case Studies

3.1.1. A case study on Axie Infinity

Axie Infinity developed by Sky Mavis represents one of the first and most successful implementations of blockchain-based gaming centered around tradable NFT assets. Since launching in 2018, Axie has generated over $4 billion in total NFT trading volume and achieved

[3] PoH is a consensus mechanism used by Solana that creates a historical record of when transactions occurred, using cryptographic timestamping. This allows nodes to verify the order and time of events independently [10].

[4] SPL-token standard is the common associated token standard used in Solana network [10].

over 2.5 million daily active users at its peak popularity [12], [13].

The core of Axie's economic model is driven by a P2E mechanics associated with an internal tokenized economy centered around fungible ERC-20 utility tokens, i.e., Smooth Love Potion (SLP) and Axie Infinity Shards (AXS). SLP can be earned by gamers through winning battles against their opponents in the Ranked Arena Mode. It can be used to breed Axies with varying rarity traits following a common ERC-721 standard [14], which can be upgraded through gameplay in Adventure Mode. Axies could be publicly traded on the Ronin Network, an Ethereum-linked sidechain, for AXS. Both tokens can be exchanged for fiat currency on exchanges or used to purchase additional Axies and items on Axie's internal marketplaces [15]. As of September 2022, over 1 million Ethereum wallets own at least one Axie NFT, indicating a high level of asset distribution [12]. Axie's secondary market saw over $200 million in NFT sales in July 2021 compared to only $15 million in primary sales directly from Sky Mavis [16]. With 19.5 mil. total transactions in the period, it accounts for an average of $11.03 of revenue generated per transaction. The secondary market for breeding and trading Axies is highly profitable.

During Axie’s peak popularity in 2021, over 2.5 million daily active users participated across various aspects of the ecosystem [13]. However, this number has since declined 95% to around 50,000 as of mid-2022, posing questions around long-term retention [13]. One major critique of Axie Infinity is the high barrier to entry for new gamers in terms of upfront costs. To start playing, gamers must purchase at least 3 Axies. The average price of an Axie surged to around $200 at the peak in 2021, requiring an upfront investment of $600+ just to start playing [17]. This priced out users only interested in casual gameplay. The scholarship program was intended to subsidize new players, but complex processes combined with speculation made obtaining scholarships difficult in practice [18]. This resulted in a model catered heavily

towards speculative investors rather than gamers, misaligning the economy from its original utility vision. With users focused on profit first, gameplay and community building suffered [19].

Incentives promoting speculation were further exacerbated by design choices like potions which boosted rewards. When combined with robots, this undermined the sustainability of organic reward distributions. Rampant breeding also led to hyperinflation of low-value Axies, diluting the perceived value of NFT assets [20]. Critics argue that unchecked open markets amplified volatility, with Axies traded more as financial assets than game pieces [21]. Prices became detached from underlying utility. The declining engagement down to 50,000 daily active users in 2022 signals issues in retaining true gamers.

The Axie Infinity's trajectory provides an important case study in how tokenomic structures can go astray when mechanisms to align incentives and constrain harmful speculation are absent. Governance protocols that promote sustainability and fair participation are needed.

3.1.2 A case study on FIFA series

The annual FIFA soccer video game franchise published by EA provides valuable insights into the design of virtual economies and monetization systems in modern gaming. Since its inception in 1993, the series has amassed over $20 billion in lifetime revenue, with a record $1.62 billion earned from extra content like FIFA Ultimate Team (FUT) cards in Fiscal Year 2021 [5].

FUT, first introduced in FIFA09, enables players to obtain virtual player packs and build fantasy squads [22]. This gamified the traditional Panini soccer sticker collecting culture within an innovative virtual economy. Rare player cards with special designs hold artificially scarce

supply and high demand on FUT's Transfer Market auction house. As per traditional microeconomic theory, constrained supply fuels speculative valuations, with certain premium meta cards attaining aftermarket prices of even millions of in-game credits [23]. FUT's marketplace charges 5% in-game FUT Coins as transaction fee. This regulates the total supply of in-game credits to sustain the economic ecosystem.

Digital packs contain randomly generated player assets, like physical trading cards. However, drop rates for high-value cards are tuned to miniscule sub-1% probabilities [24]. When coupled with effective price anchoring tactics for pack bundles, these drives recurring monetary spending. In FY2021 alone, 2.3 billion FUT packs were opened according to EA's annual report [5]. FUT Coins earned slowly through gameplay present a high grind time for premium cards. Consequently, most players opt for upfront real-money purchases. Dibonaventura analyzes this as a manifestation of induced value theory, whereby the randomized packs leverage prospect theory principles to increase subjective valuations [25]. Furthermore, Chang applies Maslow's hierarchy to posit social esteem needs within the FUT community are met through rare squads, forming a basis for pack purchases [26].

While generating billions in revenue, FIFA's closed, proprietary ecosystem impedes open asset markets and cross-title portability that would benefit players [27]. For example, FUT cards and coins remain locked within each annual version, preventing carryover to future titles. This diminishes long-term utility and liquidity for players' hard-earned virtual assets. In economic terms, restricting secondary markets leads to market inefficiencies and value leakage from the ecosystem.

Exploration of emerging blockchain-based solutions, decentralized finance (DeFi) protocols, and tokenized governance enable next-generation community owned ecosystems being aligned with Web 3.0 philosophies [27], [28]. NFTs allow true digital asset ownership

persistence, trustless exchange, and provable scarcity across platforms [29]. Decentralized autonomous organizations (DAOs) offer new avenues for cooperative management and participatory dynamics for online communities [30]. Integration of these technologies presents opportunities to remedy current limitations. Features like cross-title NFTs, player-governed economies, trustless peer-to-peer marketplaces, and permissionless metadata could strengthen engagement, agency, and value flows in future iterations of virtual gaming economies [31]. Meanwhile, challenges around speculation, sustainability, and off-chain governance must also be addressed as demonstrated by existing Web 3.0 experiments with prudent research and design thinking.

3.2. Proposed Tokenomics

Industry research indicates a significant demand for public exchange that facilitates the trading of in-game assets while preserving the sustainability of the ecosystem. A case study of Axie Infinity reveals that the game's currency tokens underwent hyperinflation, creating a barrier for new players wishing to enter the ecosystem. To address these challenges, this project proposes the implementation of a dual token system (see Figure 1). This system includes a currency token, used primarily for transacting in-game utilities, and a governance token, which allows holders to participate in decision-making processes.

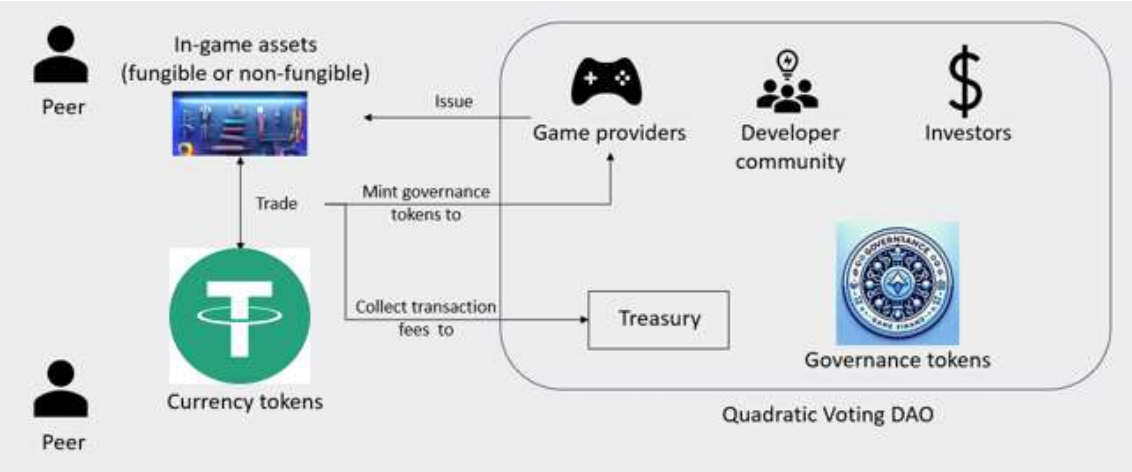

Figure 1. Flow chart demonstration of the proposed tokenomics.

3.2.1. Currency Token

In this project, the currency token is designed to function as the medium of exchange, enabling gamers within the network to trade in-game assets freely with their peers. To ensure ease of transaction and stability, the currency token will be a stablecoin. Insights from the Axie Infinity industry research highlight that hyperinflation and excessively fluctuating currency prices can deter potential participants from joining the network. Initially, the project considered developing a new stablecoin from scratch to serve these needs. However, after careful consideration, it was decided to adopt USDT on the Solana network instead.

Choosing USDT over creating a new stablecoin offers several advantages. Firstly, USDT is already a widely recognized and established stablecoin, linked to the value of the US dollar, which provides inherent stability and trust. By using USDT, the project can leverage its existing infrastructure and liquidity, which significantly reduces the technical and financial risks associated with launching a new token. Furthermore, integrating USDT allows for immediate interoperability with a broad range of existing financial tools and services within the cryptocurrency ecosystem. This decision accelerates the deployment timeline and lowers the barriers for user adoption, as users are more likely to trust and adopt a well-known stablecoin rather than a new and untested token. Thus, using USDT enhances the project's feasibility and potential for success by providing a reliable and stable currency environment.

In this framework, gamers could exchange in-game utilities using USDT. This setup facilitates game providers in the issuance of both fungible and non-fungible tokens, which symbolize the entitlement to various in-game utilities. When these utilities are tokenized, they are linked to a transfer hook smart contract[5]. This contract is programmed to enforce a rule

[5] Transfer hook is a framework proposed in Solana Token 2022 Extensions. It allows developers to attach smart contracts with custom business logics performed in transactions.

whereby every transaction involving the tokenized in-game utilities incurs a transaction fee of 3%. This fee structure is automatically applied to ensure compliance and facilitate the seamless collection of fees. This mechanism not only supports the economic structure of the gaming ecosystem but also provides a method for game developers to monetize their offerings.

3.2.2. Governance Token

This project introduces a governance token that embodies the voting power within a quadratic voting DAO (Decentralized Autonomous Organization). The transaction fees generated from trading game assets are accumulated in the DAO's treasury. These collected fees are then proportionally distributed among holders of the governance token. Additionally, every time a game asset transaction occurs, new governance tokens are minted for the issuer of the game assets. The quantity of these newly minted tokens corresponds directly to the value of the transaction fee collected.

This strategy ensures that issuers are compensated with governance tokens, thus fostering their active engagement in the development and management of the ecosystem. One primary reason for not distributing transaction fees directly to game providers is to stimulate competition among them. Since new governance tokens are minted and transaction fees are distributed proportionally based on the overall supply of governance tokens, providers are motivated to create game utilities that enhance gamers' willingness to engage in transactions. This dynamic encourages the development of appealing game features, contributing positively to the ecosystem's sustainable growth.

Additionally, other network participants, such as developers, are also incentivized to take part in this ecosystem. Developers who hold governance tokens possess the authority to oversee, maintain, and propose modifications to the ecosystem, and they receive rewards for their

contributions. Initially distributing governance tokens to developers provides them with a share of the transaction fees, thereby motivating them to join and actively contribute to the network.

This approach not only rewards current contributions but also strategically aligns the interests of various stakeholders—game providers, developers, and gamers—towards the collective growth and sustainability of the ecosystem. By integrating this governance model, the project ensures a balanced distribution of power and incentives, which is crucial for the long-term success and adaptability of the gaming platform.

As the project progresses, it is anticipated that governance tokens will increasingly accumulate among game providers. To ensure that developers also have a significant role in decision-making processes, this project incorporates a quadratic voting DAO (Decentralized Autonomous Organization). This voting mechanism is specifically chosen because it democratizes the decision-making process.

Quadratic voting is a system where the cost of each additional vote cast by a participant for a particular decision grows exponentially [40]. This means that if a participant strongly supports an issue, they can choose to allocate more votes to it, but at an increasing cost. This method effectively balances the influence among stakeholders, preventing those with larger holdings of tokens from having disproportionate power. It encourages more equitable participation from all members, including developers who might have fewer tokens compared to large game providers.

3.3. Software Architecture

This project delivers the architecture using Next.js framework for frontend, Express.js framework for the API, and the Solana blockchain as the backed ecosystem (refer to **Appendix A** for detailed implementation, user manuals, and functional specifications).

The frontend application functions as the primary interface for gamers, facilitating a range of interactive activities. Upon integrating their keys with the Phantom wallet, gamers connect to the frontend where they can manage and view their owned assets. This platform also enables them to actively participate in the marketplace: they can browse available assets, and depending on the type of asset, engage in trading. For fungible in-game assets, gamers can list a bid or ask price in the market book, effectively setting their buying or selling price. For non-fungible game assets, the application supports auction-based trading[6], allowing gamers to place bids. These real-time market data is processed in a centralized database[7], i.e., using DynamoDB and Lambda functions with AWS. This comprehensive interface is designed to be user-friendly, promoting an engaging and efficient trading experience that enhances the overall gaming experience.

The API serves as a crucial endpoint for game providers, integrating seamlessly with their gaming applications. This integration allows game providers to conduct primary sales directly to gamers by minting the required fungible or non-fungible assets and distributing them according to the gamer's public key. Additionally, the API provides functionalities for game providers to query and ascertain which game tokens each gamer possesses. This capability enables providers to tailor the in-game utilities they offer, ensuring that gamers receive the appropriate assets and experiences based on their holdings.

[6] This project adopts second-price seal-bid auction to maximize revenues. Second-price auction suggests selling the item to the highest-price bidder with the second-highest bid as the price in a sealed-bid auction in a game-theoretic approach [41].

[7] An architectural concept like Binance – the trades are being matched in a centralized ecosystem market book first before executed in the network.

4. Future Development

In the future development of the project, a possible and significant enhancement is the establishment of a DEX. This will be modeled on the principles of the Uniswap protocol, a renowned framework in the cryptocurrency space known for its automated liquidity provision on Ethereum [42]. By adopting a similar decentralized trading model, the platform will allow gamers and asset providers to engage in direct and secure exchanges without the need for intermediaries. This approach not only increases transaction efficiency but also enhances security, as it reduces reliance on central entities that could be potential points of failure or targets for malicious activities. The implementation of a DEX will enable real-time trading of game assets, with prices driven by market dynamics and liquidity. Gamers will be able to trade assets instantly at current market prices, fostering a more active and fluid market environment. This setup will support a wide range of assets, thus enhancing the trading experience and options available to users.

In conjunction with the decentralized exchange, the next phase of development involves the creation of a liquidity pool specifically designed for trading game assets. This liquidity pool will be integral to the DEX, providing the necessary liquidity to facilitate smooth and efficient asset trades. To incentivize participation in the liquidity pool, the project plans to introduce liquidity staking rewards. Participants who contribute their assets to the pool will receive rewards based on the amount of liquidity they provide. These rewards will be distributed in the form of governance tokens, or a portion of the transaction fees generated from the trades executed within the pool. The feature of liquidity staking is intended to attract and retain a stable base of liquidity providers, which is essential for the health and success of the exchange. By offering rewards, this project aims to encourage a robust participation rate, ensuring that there is always sufficient liquidity to meet the trading demands of the platform's users. This

approach not only benefits the liquidity providers through rewards but also enhances the overall user experience by enabling quicker and more reliable trade execution.

As part of our future development, we plan to publish a detailed white paper that outlines our platform's technical architecture, economic model, and governance structure. This document will provide essential information to educate potential investors and users about our project. Following this, we will initiate an ICO for our governance token. The ICO will fund further development and enable early stakeholders to invest, influencing the platform's direction through decentralized governance. This process will ensure community involvement in decision-making, fostering a transparent and user-empowered ecosystem.

5. Summary

In this project, Axie Infinity and FIFA series serve as case studies leveraging blockchain technology in gaming ecosystems. The project introduces a governance token, central to a DAO operating on a quadratic voting system, to incentivize the active participation of various stakeholders, including game issuers and developers. Issuers are awarded governance tokens based on transaction fees from game asset trades, fostering engagement and competition, while transaction fees are redistributed among token holders to promote ecosystem growth. Furthermore, the project utilizes a software architecture employing Next.js and Express.js frameworks, with Solana blockchain integration, which facilitates a dynamic and user-friendly gaming marketplace. Looking forward, the development plan includes establishing a DEX based on the Uniswap protocol to allow direct, secure exchanges of game assets without intermediaries, enhancing transaction efficiency and security. This future phase will also introduce a liquidity pool with staking rewards to ensure sufficient market liquidity and encourage broader participation in the platform. Overall, the project emphasizes sustainable

ecosystem growth through strategic incentivization and robust technological infrastructure, aiming for a decentralized, stakeholder-driven gaming economy.

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Appendix A – Detailed Implementation

View the implementation at https://github.com/jacky-wong9273/fyp23046.