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## BETZILLA

*Trust the Code, Not the House*

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Academic Year 2024–2025

# Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>The Problem</b>	<b>5</b>
2.1	Betting Dynamics . . . . .	5
2.2	NFTs . . . . .	6
2.3	Case Studies . . . . .	6
2.3.1	The Greyhound Racing Heist . . . . .	6
2.3.2	Outcomes . . . . .	7
2.3.3	NFL Favorites Upset the Books . . . . .	7
2.3.4	Outcomes . . . . .	7
2.3.5	Sorare's Fantasy Football Blockchain Revolution . . . . .	8
2.3.6	Outcomes . . . . .	8
<b>3</b>	<b>The BetZilla Solution</b>	<b>9</b>
3.1	Blind Betting . . . . .	9
3.2	Odds Calculation . . . . .	9
3.2.1	Fair Fee System . . . . .	10
3.3	Handling Edge Cases . . . . .	10
3.3.1	Market Validation Process . . . . .	10
3.3.2	Cancellation Triggers . . . . .	10
3.3.3	System Benefits . . . . .	11
3.4	Players NFTs . . . . .	11
3.5	Sports Betting Market Growth . . . . .	11
3.6	Business Model and Revenue Streams . . . . .	12
3.7	Value Proposition Canvas . . . . .	12
<b>4</b>	<b>System Architecture</b>	<b>14</b>
4.1	Frontend . . . . .	14
4.2	Backend . . . . .	15
4.3	Smart Contract . . . . .	15
4.3.1	Core Data Structures . . . . .	15
4.3.2	Core Functionalities . . . . .	16
4.3.3	Automated Workflow (Current and Future) . . . . .	17
<b>5</b>	<b>Bet Workflow</b>	<b>18</b>
5.1	Bet Placement . . . . .	18
5.2	Mathematical Parimutuel Model . . . . .	19
<b>6</b>	<b>Real-world Implementation Status</b>	<b>21</b>

<b>7</b>	<b>Future Improvements</b>	<b>22</b>
7.1	User-to-User Betting Exchange . . . . .	22
7.2	NFT-Based Fantasy Competitions . . . . .	22
7.3	Strategic Partnerships and Special Events . . . . .	22
7.4	Blockchain Upgrades . . . . .	22
7.5	Why? . . . . .	23
<b>8</b>	<b>Conclusion</b>	<b>24</b>

# 1 Introduction

The online betting industry is expanding rapidly, offering sports enthusiasts the ability to place wagers from their devices with just a few clicks. However, the majority of these platforms operate under a centralized model, where a single entity controls operations. They often lack transparency in how odds are calculated and how user funds are managed. This opacity can lead to user distrust, hindering growth and undermining confidence in the system.

BetZilla aims to revolutionize this paradigm with a decentralized, blockchain-based application. Our slogan, *Trust the Code, Not the House*, encapsulates the core mission: to create a betting environment where rules are transparent, automated, and not subject to the decisions of a central operator. Instead of a company setting fixed odds, BetZilla implements a parimutuel system where odds are dynamically determined by the collective betting behavior of the community, ensuring a fair and decentralized process.

At its core, BetZilla operates on immutable smart contracts deployed on a public blockchain. These contracts autonomously manage the entire betting lifecycle: from market creation and bet collection to odds calculation and winner payouts, all transacted in cryptocurrency. All actions are recorded on the blockchain, creating a permanent, transparent record that no single party can alter. This decentralized architecture prevents cheating and manipulation while being designed to scale and handle a high volume of concurrent bets.

To further enhance user engagement, BetZilla integrates a collection of player-based Non-Fungible Tokens (NFTs). These digital collectibles represent real athletes at various rarity levels. Owning an NFT of a specific player grants bonus rewards on winning bets involving that player or their team. These NFTs are tradable on the platform's integrated marketplace, creating a dynamic internal economy that adds value and excitement for active users.

This document provides a comprehensive overview of BetZilla's architecture, features, and strategic vision. We will detail the design of the smart contracts, the mechanics of dynamic odds calculation, the functionality of the NFT system, and its future potential. Through this analysis, we will demonstrate how BetZilla is set to redefine the online betting experience by placing trust in open-source code and community participation.

## 2 The Problem

We have chosen to move away from traditional platforms because they do not guarantee transparency to users. Odds are established by an oracle often oriented to favor the house, while the criteria used to calculate those values are never disclosed. To summarize the main critical issues of centralized betting systems, we have identified some key points.

- **Lack of Transparency:** Most betting platforms do not disclose the algorithms used for odds calculation or the protocols for fund management. This creates an information asymmetry that favors the house and fosters distrust among users
- **Odds Manipulation and Unfair Practices:** Centralized control allows platforms to adjust odds to maximize their profits, potentially at the expense of fairness. Policies can be changed without user consent, and payouts can be delayed or disputed without a clear recourse for the user
- **Limited User Engagement:** In traditional systems, users are passive participants. They have no say in how odds are set, how markets are resolved, or how the platform evolves

### 2.1 Betting Dynamics

The problem consists of defining an odds calculation method that, on one hand, protects our company from substantial losses given the limited initial capital, and on the other hand, incentivizes users to bet on our platform. To develop an improved version of this system, we have analyzed the critical issues related to odds determination.

1. **Malicious Coalitions:** Agreements between multiple bettors who initially bet in large numbers on the underdog team of an event (more generally, on the less probable outcome) to artificially inflate the odds in favor of the favored team (the event with higher probability of success). Once the desired effect is achieved, they place very high-value bets on the modified odds of the favorite, thus obtaining substantial profits
2. **Detection of cooperation:** It is difficult to determine whether a bet is placed genuinely or with the intent to manipulate odds. Furthermore, it is challenging to reconstruct all the actions that led to odds manipulation, making it practically impossible to identify all those responsible for the incident

3. **Odds definition:** It is difficult to find a mechanism that can calculate odds dynamically to limit platform losses. Moreover, this would compromise the concept of clarity, which is a strong point of our platform
4. **Revenue:** Frequently used mechanisms do not leave a large profit margin for the platform, so it is necessary to understand where to derive profit without damaging user experience (by introducing invasive advertising)

## 2.2 NFTs

A fundamental aspect that requires particular attention is NFT management, since our platform will include collectible items divided by rarity (base, rare, legendary). Ownership of these NFTs will influence betting by modifying odds for users who bet on the player represented by their NFT or on their team's victory, whether club or national. Below are the key points to analyze in order to ensure proper management of the mechanism.

1. **Regulatory uncertainty:** To create NFTs of real players, we need licenses and agreements with the parties involved. Furthermore, the possible definition of NFTs as securities implies licensing and compliance requirements that vary depending on jurisdictions
2. **Fair Bonus Attribution:** We must establish the criteria for attributing bonuses. Should they be given based on the player's current performance, or should they depend solely on the rarity of the card obtained?
3. **NFT market manipulation:** NFTs themselves can be subject to wash trading [4] or other maneuvers aimed at increasing their value
4. **NFT creation:** Beyond being a source of bonuses for potential bets, we also want to bring art into our platform by generating interest in our NFTs. For this purpose, we want each NFT to be created by an artist, making every card a true masterpiece

## 2.3 Case Studies

To thoroughly understand the problems, it is necessary to examine real cases that have occurred to identify the key that allows us to find an effective remedy.

### 2.3.1 The Greyhound Racing Heist

This case study deals with an event that occurred in 1964 known as The Dagenham Coup[11].

This took place in the context of greyhound racing, and for this plan to succeed, they selected a race where two dogs had no chance of winning and recruited approximately 170 people to place bets on the remaining dogs, block the stadium's telephone lines (since if they had been active, someone would have noticed the anomalous variation in odds), and the rest blocked all betting counters to bet only and exclusively on the losing dogs.

The scheme generated approximately six hundred thousand pounds which, at current currency value, corresponds to about eleven million pounds. All of this works against those who issued the bets since they had to pay back all the players.

### **2.3.2 Outcomes**

This type of problem must not occur because we would lose a large amount of money and would have to face potential economic debts. Additionally, some bettors who had genuinely bet on the underdog odds might have reduced payouts precisely due to external manipulation.

### **2.3.3 NFL Favorites Upset the Books**

Flutter Entertainment recorded a negative impact of \$370 million due to player winnings on NFL bets. The most significant episode was the Detroit Lions' victory against the San Francisco 49ers, which alone resulted in a loss of \$74 million. The 2024/2025 NFL season was defined as the most customer-favorable since the launch of online sports betting, with a favorite team win rate unseen in the last twenty years [8].

Sports betting operators rely on complex statistical models and pricing algorithms to balance wagers on both teams and guarantee a profit margin through commission. In theory, even in case of unfavorable outcomes, the commissions should protect bookmakers, but a prolonged series of favorite wins can rapidly weaken this margin. This case highlights how unexpected fluctuations in sports results can pressure even the most sophisticated risk management systems.

### **2.3.4 Outcomes**

This example demonstrates that, regardless of adopting complex and sophisticated mathematical models for odds calculation, we can never have certainty of obtaining profit. Consequently, it is necessary to develop an alternative strategy to address these critical issues.

### **2.3.5 Sorare’s Fantasy Football Blockchain Revolution**

To provide a concrete example of what we want to introduce within the platform, we can refer to Sorare [6], which is a Fantasy Football Game based upon Blockchain, where you can win rewards for picking the best lineups. On Sorare, you can manage your teams, enter tournaments, trade your cards and build the perfect collection.

On Ethereum, Sorare issues tokens according to the ERC-721 standard to uniquely represent digital player cards. Each season, five rarity categories are created (Common, Limited, Rare, Super Rare and Unique), each with a predetermined number of editions and differentiated market value. To contain gas costs and ensure speed, minting and exchange transactions occur on a ZK-rollup sidechain based on StarkWare, while preserving the security of the Ethereum mainnet.

Primary distribution occurs through weekly on-chain auctions managed directly by the platform, while the secondary market relies on an off-chain order-book with on-chain settlement, combining trading speed with certainty of blockchain registration. A 5% commission is applied to each secondary sale to support the internal economy, while clubs and leagues receive variable royalties from 10 to 20% on primary revenues and 1 to 2% on market transactions.

### **2.3.6 Outcomes**

We can therefore say that NFT management is burdensome from the perspective of legislative criteria and also from the blockchain management perspective. Seeing the concrete example of Sorare, we can draw inspiration and succeed in creating an efficient model that complies with all current regulations.



## 3 The BetZilla Solution

Taking into account the critical issues that emerged in the previous chapter, we now present the solutions adopted and explain why these mechanics are effective in a highly competitive market such as online betting.

### 3.1 Blind Betting

The core mechanism for odds calculation is **blind betting**, where users place wagers on one of the possible outcomes (home win, draw, away win) *without knowing the odds*. These odds are constantly updated until they become immutable at the start of the match. In this model, the odds for each outcome are inversely proportional to the amount wagered on the other outcomes. This protects the platform from significant losses in case of unlikely results.

- **Discourages strategic manipulation:** Since odds are based purely on the distribution of bets and not influenced by dynamic algorithms, the system resists manipulation
- **Incentivizes participation:** The hidden odds add suspense and entertainment, encouraging user engagement

### 3.2 Odds Calculation

As introduced earlier, odds are determined using a mathematically rigorous **parimutuel model** [9]. The odds for an outcome  $i$  are calculated with:

$$\text{odds}_i = \frac{\text{totalAmount}}{\text{amount}_i}$$

Where:

- **totalAmount** is the total amount staked across all outcomes.
- **amount<sub>i</sub>** is the total amount staked on outcome  $i$ .

To encourage early participation, provisional odds are displayed **24 hours before the event**. These values fluctuate with each new bet and are only finalized at kick-off. This approach provides users with market insight without misleading them into thinking the displayed odds are fixed.

### 3.2.1 Fair Fee System

BetZilla’s economic sustainability is achieved through a dynamic fee applied only to **net winnings** (payout minus original stake). Users never pay fees on their initial bet, which makes the system more attractive and fair.

- **Early Fee (2%)**: Applied to users who have bet on non-visible odds, as it encourages early participation in the competition
- **Late Fee (3%)**: Applied to bets placed while odds are visible

The final payout for a winning user is computed as:

$$payout = amount\ betted \times odds \times \left(1 - \frac{fee}{100}\right)$$

## 3.3 Handling Edge Cases

Events may not always achieve the expected participation levels, making it essential to have clear procedures that preserve user experience and prevent unfair losses. We have developed dedicated solutions with automatic validation mechanisms to address these scenarios.

### 3.3.1 Market Validation Process

Before closing bets, the contract performs comprehensive checks to ensure market viability. The system verifies that there are wagers on at least two different outcomes and that the pool size meets minimum requirements. When these conditions are not satisfied, the market is automatically flagged as canceled (`isCancelled = true`), enabling users to claim full refunds.

### 3.3.2 Cancellation Triggers

Markets are automatically canceled under the following conditions:

- No bets are placed
- Only one user or outcome receives wagers
- Total pool falls below the `MIN_POOL_SIZE` threshold

### 3.3.3 System Benefits

This approach provides multiple advantages:

- **Security:** Prevents payout errors such as division by zero
- **Fairness:** Ensures only competitive and valid markets proceed
- **Transparency:** Provides automatic refunds for invalid markets
- **Platform Protection:** Safeguards against manipulation and financial losses

Additionally, we will implement an automatic refund system to maintain high user trust throughout the process.

## 3.4 Players NFTs

To attract a larger number of users and strengthen their loyalty, BetZilla introduces NFTs inspired by real champions. These tokens will allow us to create a community of enthusiasts, launch contests for their design, and involve subscribers in creating true works of art through collaboration with professional artists.

- NFTs represent real athletes, categorized by rarity (e.g., Common, Rare, Legendary)
- Holding an NFT tied to a player or team grants **bonus multipliers** on winning bets
- NFTs are tradeable on an internal marketplace, creating a secondary economy driven by rarity and performance

Through these tokens, we will be able to highlight our image on social media and appear in videos by well-known YouTubers, increasing visibility and strengthening our brand recognition.

## 3.5 Sports Betting Market Growth

We are entering a rapidly expanding market that has experienced exponential growth over the last decade, driven by the proliferation of increasingly accessible and secure digital platforms. These services enable players worldwide to connect at any time, comfortably from home or on the go, using smartphones and tablets to access an increasingly diverse and personalized gaming experience. According to recent reports, the market was valued at around \$106 billion in 2024 and is projected to exceed \$1850 billion by 2029, with a CAGR over 12%.

## Online Gambling Global Market Report 2025

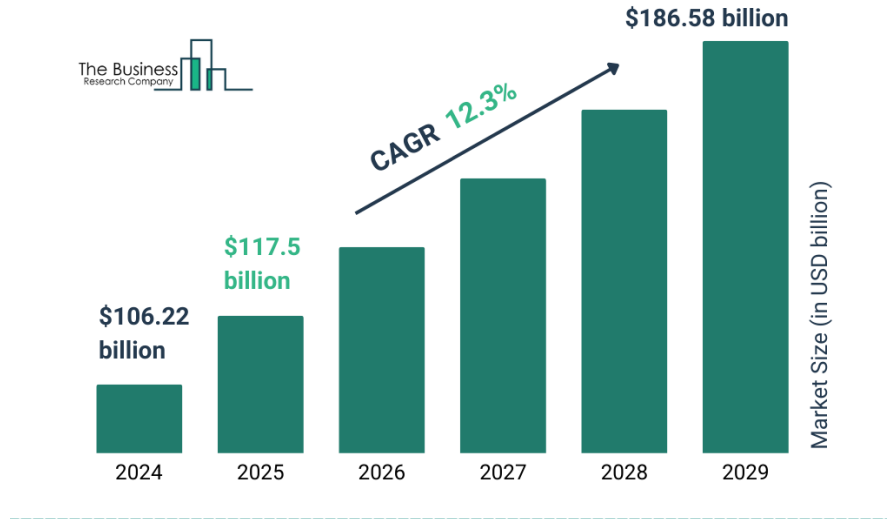


Figure 1: Global sports betting market growth [7]

Despite the continuous expansion of this market, there is a scarcity of solutions that prioritize trust and transparency, offering a service free from deception and completely transparent toward users.

### 3.6 Business Model and Revenue Streams

To address the issues highlighted previously, we have introduced BetZilla, a platform that aims for transparency in every aspect toward users. Our primary source of revenue consists of a commission of 2/3% on the net income from each victory; this mechanism is managed by immutable smart contracts whose code is made public to avoid raising suspicions. The platform generates revenue only when a user wins, while as a secondary source it produces and sells NFTs, applying a small commission also for their transfer.

### 3.7 Value Proposition Canvas

To illustrate in detail the potential of BetZilla, we have created a value proposition canvas, a framework designed to ensure that a product or service is positioned based on the real needs and preferences of stakeholders. This tool highlights the blockchain implementation and the fundamental pillars that have inspired us.

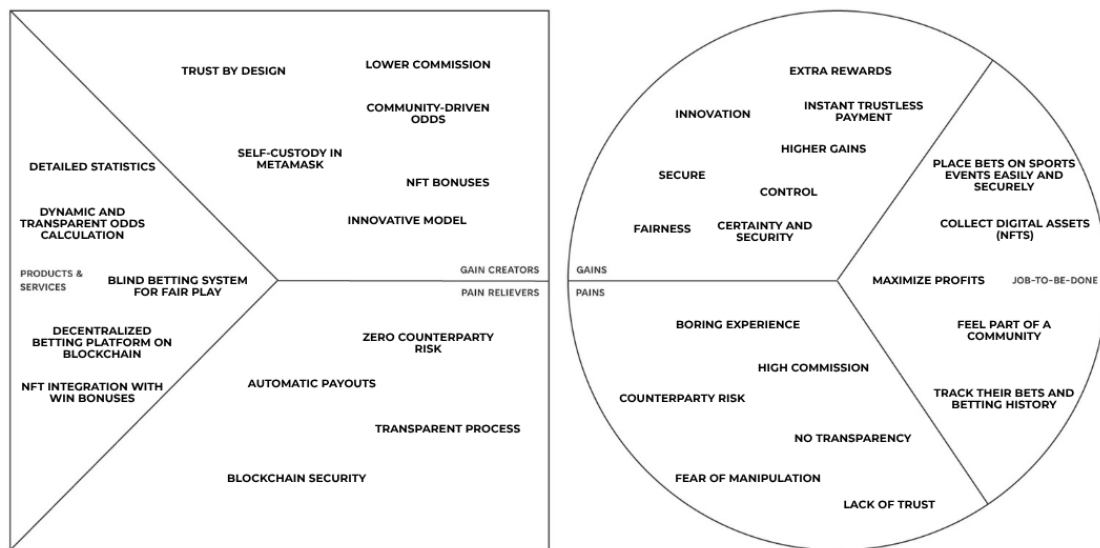


Figure 2: Value Proposition Canvas for BetZilla

## 4 System Architecture

For the web page implementation, we have chosen to use TypeScript with React alongside Bootstrap to create a Single-page application [10], providing an attractive interface that is perfectly adaptable to any device, both mobile and desktop. For the backend, we have opted for Node.js and a customized MySQL database, which allows us to efficiently manage information related to bets and user activities. On the blockchain front, we utilize Ethereum with smart contracts in Solidity, as it guarantees complete transparency through publicly verifiable code, automatic payments without intermediaries, a mature ecosystem with established tools, and proven security supported by a vast community of developers. This modular architecture ensures not only platform protection but also its scalability according to future needs.

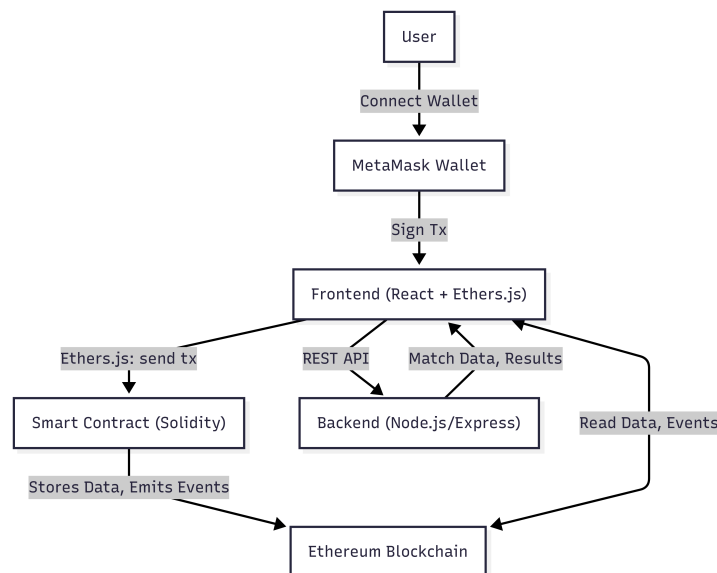


Figure 3: High-level architecture of BetZilla.

### 4.1 Frontend

The frontend represents the users' access point to the platform, therefore the interface must be intuitive, free from complex elements that could discourage visitors, and capable of actively engaging them in the gaming experience.

- **Wallet Integration:** Users connect via MetaMask or other wallets to interact directly with smart contracts

- **Browse Available Matches:** Allows viewing of all events available for betting and displays event information
- **Bet Placement:** Place blind bets with client-side validation and clear transaction prompts
- **User Dashboard:** Track active and past bets, winnings, and NFT collections
- **NFT Marketplace:** Enables viewing of all available NFTs in the market (published by both users and the platform) and allows their purchase

## 4.2 Backend

The backend manages the system logic and coordinates the frontend: it executes user-requested operations on the blockchain and stores necessary information in the database to provide statistics and personalized data.

- **Sports Data Integration:** Component that provides available matches worldwide to enable event creation
- **Oracle Integration:** We need an oracle to obtain exact match results and consequently distribute all funds among winners
- **REST API:** Provides endpoints for the frontend to retrieve match data, historical statistics, and user analytics
- **Database:** Since users access the platform exclusively via MetaMask, user data associations are managed through their public wallet address. This approach eliminates the need for traditional registration and simplifies user management, as all relevant data (bets, history, NFTs) is linked directly to the wallet address

## 4.3 Smart Contract

The smart contract is the trustless core of BetZilla, guaranteeing transparent execution of all betting logic on an Ethereum-compatible blockchain.

### 4.3.1 Core Data Structures

Markets and bets are managed on-chain, each linked to a real-world event.

```

// BetZilla.sol (Core Structures)
enum Outcome { None, Home, Draw, Away }
struct Market {
    string description;
    uint256 totalAmount;
    uint256[3] outcomeAmounts;
    bool isClosed;
    bool isResolved;
    bool isCancelled;
    Outcome winningOutcome;
    uint256 startTime;
    uint256[3] finalOdds;
}
struct Bet {
    Outcome outcome;
    uint256 amount;
    bool claimed;
    bool refunded;
    uint256 placedAt;
}
mapping(uint256 => Market) public markets;
mapping(uint256 => mapping(address => Bet)) public bets;

```

#### 4.3.2 Core Functionalities

- **Market Creation:** The backend (or owner) creates new markets on-chain for each match
- **Bet Placement:** Users place bets on open markets. Only one bet per user per market is allowed, enforced by the contract
- **Odds Calculation:** Odds are calculated using the parimutuel formula and updated live as new bets arrive
- **Manual Resolution:** The contract owner currently sets official results manually (via `setResult()`), as a placeholder for future oracle automation
- **Payouts and Refunds:** Winners can claim payouts (stake + winnings minus fees). If a market is cancelled (e.g., insufficient pool or only one outcome bet), users can claim full refunds
- **Security:** Solidity best practices are enforced: access control, input validation, event logging, and reentrancy protection. All state changes emit events for off-chain tracking



### **4.3.3 Automated Workflow (Current and Future)**

1. The backend fetches (or generates) match data and creates corresponding markets on-chain
2. Users place bets via the frontend; bets are recorded on-chain
3. Oracle submit results
4. The contract resolves markets, calculates final odds, and enables users to claim winnings or refunds

## 5 Bet Workflow

We have dedicated an entire section to describing how bet placement and prize allocation work, in order to clarify every aspect of our system and ensure users have a complete understanding of the mechanism.

### 5.1 Bet Placement

The process of placing a bet is a coordinated sequence involving multiple architectural layers, ensuring both a smooth user experience and on-chain security.

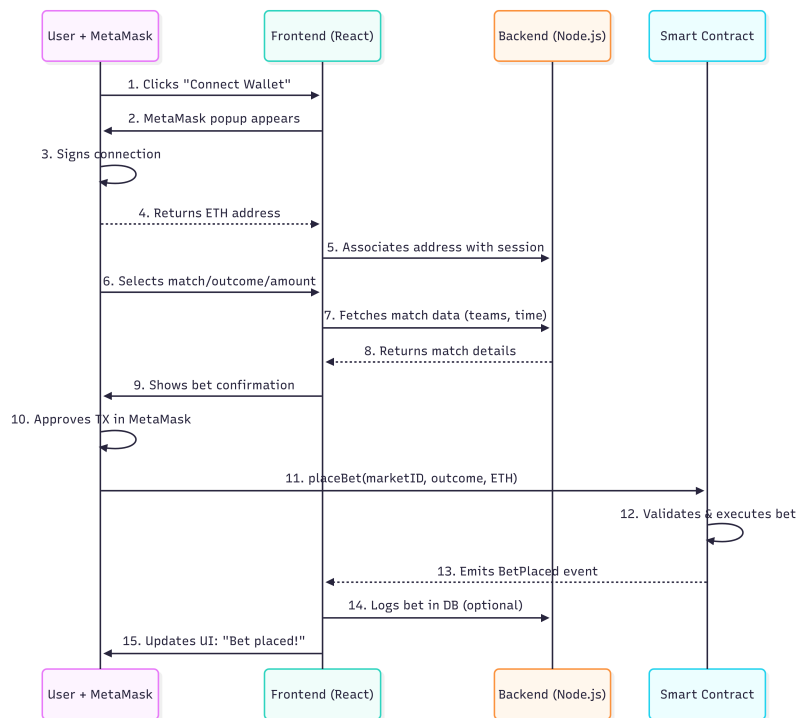


Figure 4: End-to-end bet placement sequence.

The workflow consists of these key phases:

1. **Frontend Interaction:** The user selects a market, enters the bet amount, and clicks "Place Bet". The frontend validates the input
2. **Transaction Signing:** The frontend constructs the transaction using Ethers.js and prompts the user to sign and send it via MetaMask

3. **On-Chain Execution:** The ‘placeBet’ function in the smart contract is executed. It performs critical checks:

```
// Validation checks inside placeBet()
require(!market.isClosed, "Betting is closed for this market");
require(block.timestamp < market.startTime, "Match has already
  ↳ started");
require(bets[marketId][msg.sender].amount == 0, "User has already
  ↳ placed a bet");
require(msg.value > 0, "Bet amount must be greater than zero");
```

If all checks pass, the contract state is updated, and a ‘BetPlaced’ event is emitted

4. **Post-Transaction Feedback:** The frontend listens for the event to confirm the transaction and updates the UI. The backend may also listen for this event to update its analytical database

## 5.2 Mathematical Parimutuel Model

The core of BetZilla’s engine uses the parimutuel model to ensure fair and transparent payouts.

### Odds Calculation

$$\text{Odds}_i = \frac{\text{Total Pool}}{\text{Outcome Pool}_i}$$

where:

- **Total Pool** is the sum of all bets placed on the market
- **Outcome Pool<sub>i</sub>** is the total amount staked on outcome *i*

### Net Payout Formula

$$\text{Gross Winnings} = \text{Stake} \times \text{Odds}_i$$

$$\text{Net Profit} = \text{Gross Winnings} - \text{Stake}$$

$$\text{Fee} = \begin{cases} \text{Net Profit} \times 2\% & \text{(blind phase)} \\ \text{Net Profit} \times 3\% & \text{(last 24h)} \end{cases}$$

$$\text{Final Payout} = \text{Stake} + (\text{Net Profit} - \text{Fee})$$

**Example (10 ETH bet at 1.67 odds, 3% fee)**

$$\text{Gross Winnings} = 10 \times 1.67 = 16.7 \text{ ETH}$$

$$\text{Net Profit} = 16.7 - 10 = 6.7 \text{ ETH}$$

$$\text{Fee (3\%)} = 6.7 \times 0.03 = 0.201 \text{ ETH}$$

$$\text{Final Payout} = 10 + (6.7 - 0.201) = 16.499 \text{ ETH}$$

**System Equilibrium** The model maintains balance when:

$$\sum_i (\text{Outcome Pool}_i \times \text{Odds}_i) \leq \text{Total Pool} \times (1 - \text{Fee\%})$$

## 6 Real-world Implementation Status

We currently have an MVP that demonstrates the actual appearance of the platform once published on the web. However, to ensure partial functionality of the application, we have adopted temporary solutions: all data comes from example matches (the events displayed and available for betting on the initial dashboard are fictitious and based on test data). The oracle that determines outcomes is also a mechanism controlled by the system administrator, useful for verifying the correct operation of the entire process.

We have not yet integrated NFTs, as we have not been able to create a marketplace for their trading or implement the distribution system necessary to make them available to all users.

A comprehensive test suite was developed to simulate the entire smart contract workflow, including market creation, bet placement, odds calculation, result resolution, payout claims, and fee withdrawal. The tests also cover edge cases and limit scenarios, all of which passed successfully, confirming the system’s robustness in a controlled environment.

The platform is ready for deployment on Ethereum-compatible testnets and is structured to support automated data feeds and oracle integration as soon as live sports events resume and production APIs become available.

## 7 Future Improvements

We have reached a satisfactory level of the platform, but we believe there is always room for improvement. For this reason, we want to highlight some key aspects that, in our opinion, could be introduced to attract an even greater number of users and make the platform experience more fluid.

### 7.1 User-to-User Betting Exchange

Once the platform has reached a certain amount of users, we will introduce a peer-to-peer (P2P) betting exchange. This mode, similar to platforms like Betfair Exchange [2], will allow users to both "back" (bet for) and "lay" (bet against) outcomes, setting their own odds. The platform will act as a neutral custodian, matching bets and taking a small commission on net winnings. This will create a truly dynamic market driven entirely by users.

### 7.2 NFT-Based Fantasy Competitions

We plan to introduce a fantasy football-style game built around our NFTs. Users will assemble their "dream team" by selecting NFTs from their collection. These teams will compete in tournaments where points are awarded based on the real-world performance of the corresponding athletes (like Italian fantacalcio [3]). Winners will receive prizes in cryptocurrency or exclusive, limited-edition NFTs.

### 7.3 Strategic Partnerships and Special Events

To expand our user base and increase engagement, we will organize special tournaments during major sporting events like the FIFA World Cup or UEFA Champions League, featuring unique NFT collections and larger prize pools. Additionally, we will seek collaborations and licensing agreements with professional football clubs and brands to offer official, co-branded NFTs and promotions.

### 7.4 Blockchain Upgrades

Currently, the platform uses Ethereum as the main blockchain, with a smart contract written in Solidity. In the future, we could opt for more efficient blockchains with superior throughput, such as Solana [5] or Avalanche [1], thus improving the overall system performance. This transition would reduce transaction costs and ensure greater scalability to support a growing number of users.

## 7.5 Why?

Although these improvements will require the necessary time to be implemented according to the state of the art, it will be precisely these features that will make BetZilla emerge in the decentralized betting market. Thanks to them, the platform will be able to offer unique functionalities and a superior experience to users.

## 8 Conclusion

BetZilla represents a significant step forward in the evolution of online sports betting. By leveraging the inherent transparency, security, and immutability of blockchain technology, our platform directly addresses the fundamental flaws of traditional, centralized systems. The introduction of blind betting and dynamic, community-driven odds creates a fair and manipulation-resistant environment, while the integration of NFTs adds a compelling layer of engagement and economic activity.

The architecture, combining a secure on-chain core with a responsive off-chain infrastructure, provides a scalable and user-friendly experience without compromising on decentralization. The successful implementation of the prototype demonstrates the viability of our model and lays the groundwork for future enhancements. Our vision for BetZilla is to build more than just a betting platform; it is to cultivate a self-sustaining, community-governed ecosystem where trust is guaranteed not by a central authority, but by open-source, verifiable code. As we move forward with our roadmap, we are confident that BetZilla will set a new standard for fairness and transparency in the digital betting world.



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