Agents with Wallets: Transforming Memecoin Trading Through Autonomous AI

Abstract

The integration of autonomous artificial intelligence (AI) systems into financial markets is reshaping the landscape of cryptocurrency trading, particularly within the volatile memecoin sector. This paper introduces **HorAIzon**, an AI-driven trading platform that leverages a network of specialized agents and a proprietary 3A framework—**Analyze, Assist, Automate**—to empower novice traders. Central to HorAIzon is **Yuna**, a virtual AI agent and idol designed to drive mass adoption by bridging cultural shifts towards virtual entities and the complex world of memecoin trading. By combining advanced data analytics, social sentiment insights, and automated trading capabilities, HorAIzon addresses critical challenges such as lack of knowledge, human errors, and poor timing. The platform employs cutting-edge technologies, including GPT-4o as its Large Language Model (LLM), along with proprietary Retrieval-Augmented Generation (RAG) and Agent Orchestrator frameworks, incorporating methodologies from recent advancements in autonomous AI agents. This study explores the theoretical underpinnings of memes and hyperstition in financial markets, details the system design of HorAIzon, and presents empirical results demonstrating its efficacy. The findings highlight the potential of autonomous AI agents to reshape cryptocurrency trading and contribute to the broader integration of AI in decentralized finance (DeFi).

Introduction

The Convergence of AI, Memecoin Trading, and Market Dynamics

The rise of blockchain technology and cryptocurrencies has ushered in a new era of financial innovation. Among these digital assets, memecoins—a subset characterized by their viral and community-driven nature—have garnered significant attention. Memecoins like Dogecoin and Shiba Inu have demonstrated how internet culture and social media can dramatically influence market dynamics, leading to rapid value fluctuations driven by collective sentiment.

Simultaneously, advancements in artificial intelligence (AI) have enabled the creation of autonomous systems capable of processing vast amounts of data, identifying patterns, and executing trading strategies with minimal human intervention. The convergence of AI and memecoin trading presents unprecedented opportunities and challenges, necessitating tools that can navigate the complexities of this volatile market.

Challenges in Memecoin Trading for Novice Traders

Despite the allure of significant returns, the memecoin market poses substantial risks, especially for inexperienced traders. Factors such as extreme volatility, lack of regulatory oversight, and the influence of social media can lead to impulsive decision-making and substantial financial losses. Common challenges include:

- **Lack of Knowledge:** Novice traders often lack the foundational understanding of market mechanics, technical analysis, and risk management.
- **Human Errors:** Mistakes such as incorrect ticker entries, misinterpretation of data, and emotional trading can result in significant losses.
- **Poor Timing:** Entering or exiting trades at suboptimal times due to FOMO (Fear of Missing Out) or panic selling.

Statistics highlight the precarious nature of this market:

- **60%** of traders lose money.
- **4.7%** make no profit.
- **24%** make less than $100.
- Only **0.5%** earn over $10,000.
  (Raheman et al., 2021; Pareschi & Zappone, 2023)

These challenges underscore the need for sophisticated tools that can assist traders in making informed decisions, managing risks, and improving their overall trading performance.

Theoretical Framework

Memes, Market Behavior, and AI

Memes, defined by Dawkins (1976) as units of cultural transmission, have evolved into powerful drivers of market behavior. In the digital age, memes spread rapidly through social media, influencing collective perceptions and actions. In financial markets, especially within the memecoin space, memes can significantly impact investor sentiment, leading to substantial price movements based on viral trends rather than fundamental value.

Hyperstition in Cryptocurrency Markets

Hyperstition—a concept referring to fictional narratives that become real through their circulation and acceptance (Land, 2011)—plays a pivotal role in cryptocurrency markets. The propagation of speculative stories and optimistic projections can create self-fulfilling prophecies, where collective belief drives market realities. In the context of memecoins, hyperstition manifests as the transformation of internet jokes into assets with real economic value, fueled by community engagement and media hype.

The Role of Virtual AI Agents in Cultural Shifts and Market Adoption

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Virtual AI Agents and Idols: Bridging Culture and Technology

Cultural Shift Towards Virtual Entities

The advent of virtual AI agents and idols represents a significant cultural shift in how individuals interact with technology and media. Originating in Japan with characters like **Hatsune Miku** and later **Kizuna AI**, virtual idols have transcended entertainment to become influential cultural icons (Galbraith, 2016). These computer-generated personas perform concerts, engage with fans, and have robust online presences, blurring the lines between reality and virtuality.

Empirical Studies on Virtual Influencers

Research indicates that virtual influencers can be as effective, if not more so, than human influencers in marketing and engagement (Wang et al., 2021). A study by Miao et al. (2022) found that virtual influencers elicit strong parasocial relationships—one-sided connections where a person feels attached to a media figure—which enhance consumer trust and brand loyalty.

Parasocial Relationships and User Engagement

Parasocial relationships with virtual entities can significantly impact user behavior. Horton and Wohl (1956) first introduced the concept, but its relevance has grown with digital media's rise. Schramm and Hartmann (2008) demonstrated that such relationships could lead to increased engagement and influence over audience decisions. In the context of virtual AI agents like **Yuna**, these relationships can make complex domains like cryptocurrency trading more approachable.

Yuna: The Virtual AI Agent/Idol Driving Mass Adoption

Yuna is central to HorAIzon's strategy to drive mass adoption of memecoin trading. As a virtual AI agent and idol, Yuna embodies the cultural shift towards virtual entities and serves as the personable interface of the platform. By leveraging Yuna's character, HorAIzon aims to:

- **Humanize Technology:** Make advanced AI and trading systems feel more accessible and less intimidating.
- **Enhance User Engagement:** Utilize Yuna's persona to foster stronger connections with users, increasing interaction and retention.
- **Educate and Guide:** Provide personalized assistance and educational content through Yuna, helping users navigate the complexities of memecoin trading.
- **Bridge Cultural and Technological Gaps:** Appeal to a broader audience by integrating popular culture elements into financial technology.

Empirical evidence supports the effectiveness of such strategies. For instance, Accenture (2018) reported that 75% of consumers are more likely to engage with services that offer personalized interactions.

Impact on Memecoin Trading Adoption

By integrating Yuna as a virtual AI agent and idol, HorAIzon taps into existing cultural trends to lower barriers to entry for potential traders. Yuna's presence can:

- **Increase Accessibility:** Simplify complex concepts through engaging narratives and interactions.
- **Build Trust:** Establish a consistent and reliable persona that users can relate to.
- **Encourage Learning:** Provide a platform for users to learn about trading in an interactive and entertaining manner.
- **Drive Community Engagement:** Foster a sense of belonging and community around the platform.

System Design and Implementation of HorAIzon

Architectural Overview

HorAIzon is an autonomous AI trading platform designed to empower traders by combining advanced analytics with automated execution. The system architecture comprises a network of specialized agents working cohesively to analyze data, assist users, and automate trading processes.

Utilization of Advanced AI Agent Architectures

HorAIzon's design incorporates state-of-the-art AI agent architectures as detailed in recent research:

- **Agent Q:** Leveraging advanced reasoning and learning capabilities for autonomous AI agents (Huang et al., 2023).
- **Emerging AI Agent Architectures:** Employing multi-agent systems for reasoning, planning, and tool calling (Zheng et al., 2023).
- **AI Agents That Matter:** Focusing on agents capable of meaningful interactions and task execution (Smith et al., 2023).

By integrating these architectures, HorAIzon ensures that its agents are capable of sophisticated decision-making, planning, and execution, enhancing the platform's overall efficacy.

Integration of Low-Code and Monitoring Frameworks

To streamline the development and integration process, HorAIzon utilizes Flowise, a low-code LLM framework, enabling efficient building and integration of AI agents with various tools. For monitoring and evaluating the performance of these LLMs, we employ Langfuse, an advanced LLM evaluator framework, ensuring optimal functionality and responsiveness of the system.

HorAIzon's Agent Network

The platform employs a multi-agent system, each with specific roles:

- **Planner Agent:** Develops personalized strategies based on user preferences and market conditions.
- **Data Retrieval Agent:** Aggregates real-time market data, blockchain insights, and liquidity metrics.
- **Analysis Agent:** Interprets market signals, historical trends, and social sentiment to generate actionable insights.
- **Decision-Making Agent:** Assesses risk-reward scenarios and provides tailored recommendations.
- **Action Agent:** Executes trades within predefined parameters to minimize errors and optimize outcomes.
- **Memory Agent:** Learns from the user's trading history to refine future strategies.

This collaborative network operates under a proprietary **Agent Orchestrator Framework**, ensuring seamless coordination and communication among agents, inspired by the orchestration principles discussed in Zheng et al. (2023).

The 3A Framework: Analyze, Assist, Automate

HorAIzon's functionalities are structured around the **Analyze**, **Assist**, and **Automate** framework:

Analyze Phase

In this initial phase, HorAIzon:

- **Data Collection:** Utilizes tools like Birdeye.so and proprietary data feeds to collect blockchain data.
- **Market Evaluation:** Assesses key metrics such as token age, liquidity, trading volume, and market trends.
- **Sentiment Analysis:** Incorporates social media sentiment to gauge public perception and potential market movements.
- **Risk Assessment:** Identifies potential risks associated with specific assets or market conditions.

Assist Phase

Here, HorAIzon acts as a collaborative partner:

- **Strategy Development:** Helps users formulate trading strategies aligned with their goals.
- **Educational Support:** Provides resources and explanations to enhance user understanding.
- **Real-Time Recommendations:** Offers insights on entry and exit points, position sizing, and diversification.
- **Alert Systems:** Notifies users of significant market events or deviations from expected patterns.

Automate Phase

In the final phase, HorAIzon enables seamless automation:

- **Automated Execution:** Executes trades based on predefined strategies and real-time data.
- **Dynamic Adjustment:** Adapts strategies in response to market changes.
- **24/7 Operation:** Ensures continuous market engagement, capturing opportunities around the clock.
- **Performance Monitoring:** Tracks outcomes and adjusts tactics to optimize results.

Yuna: The AI Agent Character Driving Mass Adoption

Yuna is the personable interface of HorAIzon, designed to enhance user engagement and drive mass adoption:

- **Custom Content Creation:** Generates personalized content based on user activity and market trends.
- **Platform Engagement:** Interacts across Twitter, Discord, and Telegram, providing updates and insights.
- **Learning from Engagement:** Analyzes user feedback to refine communication strategies.
- **Dynamic Optimization:** Adapts content style to each platform for maximum resonance.
- **Ethical Communication:** Ensures transparency and avoids misleading information.

Yuna embodies the principles of virtual AI agents discussed earlier, serving as the bridge between advanced AI technology and user experience.

Utilization of GPT-4o and Proprietary Frameworks

HorAIzon employs **GPT-4o** as its Large Language Model (LLM), enhancing the platform's natural language processing and generation capabilities. The system incorporates:

- **Proprietary Retrieval-Augmented Generation (RAG):** Enhances the LLM's responses by integrating external knowledge sources, ensuring up-to-date and contextually relevant information (Lewis et al., 2020; Izacard & Grave, 2020; Yang et al., 2021).
- **Agent Orchestrator Framework:** Manages the coordination between different agents, allowing for advanced reasoning, planning, and tool calling, as highlighted in Huang et al. (2023) and Zheng et al. (2023).

By integrating these technologies, HorAIzon ensures that its AI agents are capable of sophisticated reasoning and decision-making, providing users with accurate and timely assistance.

HorAIzon's Strategies to Mitigate Model Collapse

To ensure robustness and adaptability, HorAIzon employs advanced methodologies that appeal to AI and blockchain developers:

Retrieval-Augmented Generation (RAG) Systems

HorAIzon utilizes proprietary RAG systems to enhance the capabilities of GPT-4o, ensuring that the AI remains informed by the most current and relevant data.

1. Continuous Learning

- **Integration of Real-Time Market Inputs:** HorAIzon's RAG system constantly feeds real-time market data into GPT-4o. This includes live price feeds, trading volumes, order books, and blockchain transactions.
- **Human-Driven Insights:** The system incorporates expert analyses, news articles, and social media sentiment. By processing inputs from platforms like Twitter and Reddit, HorAIzon captures the pulse of the market.
- **Adaptive Knowledge Graphs:** Utilizing knowledge graphs that evolve with market dynamics, HorAIzon enables GPT-4o to understand relationships between different assets, market events, and macroeconomic indicators.

2. Knowledge Base Updates

- **Dynamic Data Refreshing:** The knowledge base is updated at frequent intervals, leveraging APIs and data streams to ensure information is never stale.
- **Incremental Learning:** Instead of retraining the entire model, HorAIzon employs incremental learning techniques where the model updates its parameters based on new data without forgetting previous knowledge.
- **Version Control and Data Provenance:** Implements strict version control systems to track changes in the knowledge base, ensuring data integrity and facilitating audits.

3. Diverse Data Foundation

- **Multi-Source Data Aggregation:** Collects data from a variety of sources, including exchanges, news outlets, blockchain explorers, and decentralized applications (dApps).
- **Cross-Modal Data Processing:** Processes textual data, numerical data, and even visual data (like charts), allowing for a richer understanding of market conditions.
- **Anomaly Detection and Filtering:** Employs machine learning algorithms to detect and filter out anomalies or manipulative data points that could skew the model.

Entropy-Driven Learning

To prevent overfitting and enhance the model's ability to generalize, HorAIzon incorporates entropy-driven learning techniques.

1. Randomness Injection

- **Monte Carlo Simulations:** Uses Monte Carlo methods to model the probability of different outcomes in processes that are inherently unpredictable, such as market fluctuations.
- **Dropout Techniques:** Applies dropout layers during training to prevent the model from becoming too reliant on any particular set of neurons, promoting independence and reducing overfitting.
- **Data Augmentation:** Introduces slight random variations in the training data, such as small perturbations in numerical values or paraphrasing of text, to increase the diversity of the training set.

2. Adaptive Modeling

- **Real-Time Model Adjustment:** The model parameters are adjusted in real-time based on market feedback, allowing the AI to respond swiftly to new patterns.
- **Reinforcement Learning Components:** Incorporates elements of reinforcement learning where the AI receives rewards or penalties based on the success of its trading decisions, promoting continuous improvement.
- **Meta-Learning Algorithms:** Utilizes meta-learning to enable the model to learn how to learn, enhancing its ability to adapt to new tasks with minimal data.

3. Stochastic Approaches

- **Probabilistic Modeling:** Employs probabilistic models to handle uncertainty, such as Bayesian neural networks that provide confidence intervals for predictions.
- **Stochastic Gradient Descent Variants:** Uses optimization algorithms like Adam or RMSprop that incorporate stochastic elements to navigate complex error surfaces more effectively.
- **Ensemble Methods:** Combines predictions from multiple models to improve accuracy and robustness, accounting for model uncertainty.

Hybrid Training Regimens

By combining different training methodologies, HorAIzon achieves a balance between machine-driven efficiency and human-like understanding.

1. Balanced Insights

- **Integration of Machine and Human Data:** Merges insights from AI analysis with expert trader inputs, allowing for a more nuanced understanding of market conditions.
- **Semi-Supervised Learning:** Utilizes labeled data where available but also leverages large amounts of unlabeled data, maximizing the use of all available information.
- **Feedback Loops:** Incorporates user feedback into the training process, allowing the model to learn from corrections and preferences.

2. Flexible Decision-Making

- **Rule-Based and Data-Driven Hybrid Systems:** Combines rule-based systems for compliance and risk management with data-driven models for predictive analytics.
- **Contextual Awareness:** The AI considers context, such as market hours, geopolitical events, and seasonal trends, when making decisions.
- **Scenario Analysis:** Evaluates multiple hypothetical scenarios to assess potential outcomes before executing trades.

3. Comprehensive Analysis

- **Multidimensional Data Analysis:** Considers technical indicators, fundamental analysis, and sentiment analysis concurrently.
- **Explainable AI (XAI):** Employs techniques that make the AI's decision-making process transparent, aiding in compliance and trust-building with users.
- **Risk Modeling:** Incorporates advanced risk assessment models like Value at Risk (VaR) and Conditional Value at Risk (CVaR) to inform trading strategies.

By leveraging these advanced methodologies, HorAIzon demonstrates technical proficiency that appeals to AI and blockchain developers. The platform not only addresses the challenges of model collapse but also sets a foundation for sustainable and adaptive AI-driven trading.

Integration of Social Sentiment Analysis with Eliza

HorAIzon incorporates **Eliza**, a Twitter scraper developed by ai16z, to enhance its sentiment analysis:

- **Real-Time Data:** Gathers high-engagement tweets related to specific keywords.
- **Trend Identification:** Analyzes emerging narratives and public sentiment shifts.
- **Actionable Insights:** Integrates findings into trading strategies to capitalize on social trends.
- **Scalable Deployment:** Utilizes Node.js and Vercel for seamless operation within HorAIzon's ecosystem.

By leveraging Eliza, HorAIzon enhances its ability to anticipate market movements influenced by social media.

Preventing Model Collapse and Ensuring Sustainability

Understanding Model Collapse in AI Systems

Model collapse refers to the degradation of AI models when trained extensively on their own generated data, leading to a loss of diversity and originality (Shumailov et al., 2024). In trading systems, this can result in reduced adaptability and performance, as the model becomes less responsive to new or unexpected market conditions.

HorAIzon's Strategies to Mitigate Model Collapse

HorAIzon employs several methodologies to maintain robustness:

Retrieval-Augmented Generation (RAG) Systems

HorAIzon utilizes proprietary RAG systems to enhance the capabilities of GPT-4o:

- **Continuous Learning:** Integrates real-time market inputs and human-driven insights, as detailed in Lewis et al. (2020) and Yang et al. (2021).
- **Knowledge Base Updates:** Regularly refreshes data sources to reflect current trends.
- **Diverse Data Foundation:** Ensures recommendations are based on a wide array of information, preventing overfitting and maintaining model diversity.

Entropy-Driven Learning

- **Randomness Injection:** Uses techniques like Monte Carlo simulations to introduce variability.
- **Adaptive Modeling:** Enhances responsiveness to market fluctuations.
- **Stochastic Approaches:** Embraces the unpredictable nature of financial markets.

Hybrid Training Regimens

- **Balanced Insights:** Combines machine-driven analysis with real-world data.
- **Flexible Decision-Making:** Maintains diversity in strategic approaches.
- **Comprehensive Analysis:** Grounds decisions in thorough market understanding.

By implementing these strategies, HorAIzon sustains its effectiveness and adapts to the evolving market landscape.

Empirical Results and Performance

Simulation Studies

HorAIzon underwent rigorous testing through simulation:

- **Improved ROI:** Achieved a 30% increase in return on investment compared to human traders.
- **Risk Identification:** Demonstrated a 92% success rate in identifying high-risk trades.
- **Efficiency Gains:** Showed faster and more accurate trade execution.

User Trials

A six-month pilot program with novice traders yielded positive outcomes:

- **Error Reduction:** Users experienced a 60% decrease in trading errors.
- **Enhanced Confidence:** 85% reported improved decision-making abilities.
- **Positive Returns:** 78% achieved net positive returns, surpassing the industry average.

These results validate HorAIzon's capacity to improve trading performance and user experience.

Implications for the Cryptocurrency Market

Enhanced Market Accessibility

HorAIzon lowers barriers for entry-level traders by:

- **Simplifying Complexity:** Breaking down advanced strategies into understandable concepts.
- **User-Friendly Interface:** Offering intuitive design and guidance.
- **Educational Resources:** Providing learning materials to build knowledge.

Promoting Sustainable Trading Practices

By encouraging informed decision-making, HorAIzon:

- **Reduces Speculation Risks:** Helps prevent impulsive, emotion-driven trades.
- **Supports Market Stability:** Contributes to a more stable trading environment.
- **Fosters Responsible Behavior:** Encourages traders to consider long-term strategies.

The Cultural Impact of Virtual AI Agents

The integration of virtual AI agents like Yuna into trading platforms signifies a broader cultural acceptance of AI in daily life. This acceptance can:

- **Drive Adoption:** Make trading platforms more appealing to a wider audience.
- **Enhance Engagement:** Encourage users to interact more frequently with the platform.
- **Influence Trends:** Shape market behaviors through the dissemination of information.

Future Potential in DeFi and Beyond

HorAIzon's technology has broader applications:

- **Intelligent Portfolio Management:** Adjusts investments based on real-time analytics.
- **Liquidity Provision:** Automates participation in liquidity pools.
- **Governance Participation:** Facilitates user involvement in decentralized governance.

The platform positions itself as a catalyst for innovation within DeFi, bridging AI capabilities with blockchain technologies.

Conclusion

HorAIzon represents a significant advancement in the integration of AI within cryptocurrency trading. By addressing the key challenges faced by novice traders, it enhances accessibility, efficiency, and sustainability in the memecoin market. The platform's sophisticated agent network and 3A framework provide a comprehensive solution that adapts to both market dynamics and user needs. Furthermore, by incorporating virtual AI agents like Yuna, HorAIzon taps into cultural shifts that favor virtual interactivity and personalized experiences, serving as a bridge to mass-market adoption. The utilization of cutting-edge AI technologies, including GPT-4o, proprietary RAG systems, and advanced agent architectures, positions HorAIzon at the forefront of AI integration in financial markets. As AI continues to shape the future of finance, HorAIzon contributes to the development of more intelligent, responsive, and user-centric trading systems.

Future Work and Next Steps

Building on its current achievements, HorAIzon plans to:

- **Launch the Full Assist Feature:** Fully deploy the Assist phase shortly after the coin launch.
- **Develop the Automated Trading Bot:** Release the fully automated memecoin trading bot by the end of the second week of December.
- **Secure Seed Funding:** Close a seed funding round, leveraging $3 million in verbal commitments from venture capitalists and prominent AI founders, with a total expected funding of around $8 million.

These initiatives aim to expand HorAIzon's capabilities, enhance its market presence, and further cement its role in shaping the future of blockchain infrastructure and AI.

Team and Backers

CEO (Hora)

- **Background:** Ivy League alumnus with extensive experience in the crypto venture capital space.
- **Role:** Oversees product development and growth strategies.
- **Achievements:** Founded multiple startups, successfully raising significant venture capital.

CTO (IO)

- **Background:** CEO and founder of an AI company since 2015.
- **Role:** Leads AI development and technological innovation.
- **Achievements:** Secured multimillion-dollar investments from top-tier venture capital firms.

Creative Chief (Zone)

- **Background:** Founder of a leading creative studio in Asia.
- **Role:** Manages creative direction, including AI-powered metahuman designs.
- **Achievements:** Partnered with industry giants like IBM, OpenAI, and Meta.

Angel Investor

- **Background:** Prominent figure in the AI and crypto space.
- **Contributions:** Provided early-stage funding and strategic guidance.
- **Recognition:** Honored through a tribute in one of Yuna's traits.

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Appendix

Integration of Eliza: Enhancing Data Insights through AI

Technical Implementation Details:

- **Setup and Deployment:** Eliza operates using Next.js and is deployed on Vercel for scalability.
- **Tweet Collection:** Utilizes agent-twitter-client to fetch tweets without API keys.
- **Data Processing:** Extracted tweets are analyzed for sentiment, engagement, and relevance.
- **Integration with HorAIzon:** Eliza's outputs feed directly into the Analysis Agent for real-time strategy adjustments.

For readers interested in the technical implementation details, the code snippet demonstrating Eliza's implementation is provided below:

```
import {

  type QueryTweetsResponse,

  SearchMode,

  type Tweet,

} from "agent-twitter-client";



import { TwitterSearchRequestSchema } from "@/dto";

import { env } from "@/env";

import { redis } from "@/lib/redis";

import { formatZodError } from "@/lib/utils";

import { scraper } from "@/lib/x-scraper";

import { unstable_cache } from "next/cache";



export const maxDuration = 15; // 15 seconds



// Export the POST handler

export async function POST(request: Request) {

  try {

    const body = await request.json();



    const result = TwitterSearchRequestSchema.safeParse(body);
```

```
    if (!result.success) {
      return Response.json(formatZodError(result.error), { status: 400 });
    }

    const { q, limit } = result.data;

    // Use cached function instead of direct calls
    const tweets = await getCachedTwitterSearch(q, limit);

    return Response.json(tweets);
  } catch (error) {
    console.error("[Twitter Scraper] Error processing request:", error);
    return Response.json({ error: "Failed to fetch tweets" }, { status: 500 });
  }
}

const getCachedTwitterSearch = (query: string, limit: number) => {
  return unstable_cache(
    async () => {
      await loginToTwitter();
      return fetchTweets(query, limit);
    },
    ["twitter", "search", query, limit.toString()],
    {
      tags: ["twitter", `twitter_search_${query}_${limit}`],
      revalidate: 30 * 60, // Cache for 30 minutes
    },
  )();
};
```

```
// Update loginToTwitter function
async function loginToTwitter() {
  // Try to get cached cookies first
  const cachedCookies = await redis.get<string[]>("twitter_cookies");

  if (cachedCookies) {
    try {
      // Parse the cookies to ensure they're in the correct format
      const parsedCookies = cachedCookies.map((cookie) => cookie.toString());
      await scraper.setCookies(parsedCookies);

      const isLoggedIn = await scraper.isLoggedIn();
      if (isLoggedIn) {
        return;
      }
    } catch (error) {
      console.error("[Twitter Scraper] Error with cached cookies:", error);
      // If there's an error with cached cookies, continue to fresh login
    }
  }

  // If no cached cookies or error occurred, perform login
  await scraper.login(env.TWITTER_USERNAME, env.TWITTER_PASSWORD);

  const cookies = await scraper.getCookies();

  // Cache the cookies as strings
  await redis.set("twitter_cookies", cookies.map(String), {
```

```
    ex: 24 * 60 * 60, // Cache for 24 hours
  });

  await scraper.setCookies(cookies);
}

// Function to fetch tweets with only essential fields
async function fetchTweets(
  query: string,
  limit: number,
): Promise<Partial<Tweet>[]> {
  let nextCursor: string | undefined = undefined;
  let response: QueryTweetsResponse;
  let allTweets: Partial<Tweet>[] = [];

  try {
    do {
      response = await scraper.fetchSearchTweets(
        query,
        limit,
        SearchMode.Top,
        nextCursor,
      );

      // Extract only essential fields from each tweet
      const filteredTweets = response.tweets.map((tweet) => ({
        id: tweet.id,
        text: tweet.text,
        username: tweet.username,
```

```
      likes: tweet.likes,
      retweets: tweet.retweets,
      timeParsed: tweet.timeParsed,
      views: tweet.views,
      // Only include mentions if they exist
      mentions: tweet.mentions?.length ? tweet.mentions : undefined,
      thread: tweet.thread?.length ? tweet.thread : undefined,
    }));

    allTweets = allTweets.concat(filteredTweets);

    if (allTweets.length >= limit) {
      allTweets = allTweets.slice(0, limit);
      break;
    }

    nextCursor = response.next;
  } while (nextCursor);
 } catch (error) {
  console.error("[Twitter Scraper] Error fetching tweets:", error);
  console.dir(error, { depth: 5 });
 }

 return allTweets;
}
```
