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Development of an Intelligent Application for Cryptocurrency Queries Using LLMs

E. C. Rodrigues[1]; F. P. S. Sá[1]; J. V. Santos[1] L. A. Viana[1]; S. A. Araujo[1]

[1]*Department of Computing, Federal University of Sergipe, 49100-000, São Cristóvão, Sergipe, Brazil*

sauloalmeida@academico.ufs.br
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This study proposes the development of an application based on a Large Language Model (LLM) to assist inexperienced investors in the cryptocurrency market. The solution aims to optimize investment decisions by analyzing historical trends and current data for each cryptocurrency. The application orchestrates the processing of inputs provided by the user, querying, in real time, a cryptocurrency expert Application Programming Interface (API) that provides price statistics, in addition to aggregating information from external sources that bring current news, potential economic instabilities, the historical context of cryptocurrencies, etc. The results demonstrate that the approach can contribute to more informed decision-making, potentially improving returns for investors with this profile.
Keywords: LLM, orchestrator, cryptocurrencies.

1. INTRODUCTION

The cryptocurrency market has emerged as one of the most disruptive financial innovations of the 21st century, challenging traditional paradigms of currency, investment, and banking intermediation. Since the launch of Bitcoin in 2009, cryptocurrencies have evolved from a technological niche into a global asset, reaching a market capitalization that has surpassed trillions of dollars at its peak. With the increasing volatility and risk associated with this market, several platforms and specialized solutions have emerged to offer support and guidance to investors seeking to maximize their gains while mitigating uncertainties. Market analysis tools, digital financial consulting, and enhanced security services are increasingly in demand as more people venture into the world of digital currencies. This movement reflects the growing need for trust and knowledge in a sector still maturing but with immense growth potential.

The use of Artificial Intelligence (AI) agents for decision-making in this type of market has gained prominence among investors. According to Oliveira (2021) [1], “The financial market is extremely volatile and complex, but it is fully possible, through study and the application of correct techniques, to develop algorithms capable of efficiently predicting the future states that stocks [or crypto-assets] will assume.”

To ensure a personalized interaction for each user, considering their preferences/interests, it is important for the application to employ an orchestrator. The implementation of an intelligent orchestrator, by coordinating and directing queries to specialized models, can be extremely efficient in LLM development, enabling more accurate and personalized responses while optimizing resources and reducing costs. This approach enables smarter and more scalable management of multiple models, enhancing the overall performance of language-based AI systems.

Thus, this work aims to develop an application based on an LLM model to assist users in making investment decisions in cryptocurrencies, aiming to maximize financial returns based on predefined metrics. In addition to real-time analyses, the model incorporates evaluations of relevant historical contexts, allowing for more robust and accurate forecasts. This approach seeks to increase the accuracy of recommendations by considering both current market dynamics and past trends, thereby providing a more effective and informed tool for cryptocurrency investors.

2. METHODOLOGY

The study was conducted using local infrastructure. Code was developed in Python, using libraries such as Django for the backend and frontend. News API was used to retrieve recent cryptocurrency-related news, and the OpenAI API was used for natural language model integration. The system was also designed to interact with the CoinMarketCap API, which provides real-time cryptocurrency data.

The application is composed of three main agents: the Orchestrator Agent, the CoinMarketCap Agent, and the Web Search Agent.

2.1 Application Architecture

The architecture is composed of three main agents, each with specific responsibilities, that together ensure the retrieval and consolidation of relevant cryptocurrency market information:

- **Orchestrator Agent:** Responsible for receiving user queries, evaluating which specialized agent can provide the best response, and consolidating information to return a final answer to the user.
- **CoinMarketCap Agent:** ESpecialized in accessing the CoinMarketCap API to obtain updated data on prices, rankings, and market capitalization of cryptocurrencies.
- **Web Search Agent:** Capable of performing web searches to collect contextual information, recent news, and analysis about cryptocurrencies.

2.2 Implemented Algorithms

2.2.1 Orchestrator Agent

```
receive_query(user)
intent = analyze_intent(query)
if intent is market data:

   response = call_coinmarketcap_agent(query)

else:
   response = chamar_agente_busca_web(query)
send_response(user, response)
```

2.2.2 CoinMarketCap Agent

```
receive_query(query)

parameters = extract_parameters(query)

data = request_coinmarketcap_api(parameters)

response = format_response(data)
```

```
send_response_to_orchestrator(response)
```

2.2.3 Web Search Agent

```
receive_query(query)

results = perform_web_search(query)

information = extract_relevant_information(results)

response = format_response(information)

send_response_to_orchestrator(response)
```

2.3 Datasets and Frameworks Used

2.3.1 Django

The Django framework was used to develop both the backend and frontend of the application, providing a robust and scalable structure. The OpenAI API was integrated to enable the use of natural language models, allowing for intelligent and dynamic user interactions. The CoinMarketCap API was employed to provide real-time cryptocurrency market data, including prices, rankings, and market capitalization, enriching the application's responses. Additionally, the News API was incorporated to obtain contextual information and recent news.

2.4 Hardware

CPU: Intel Celeron 6305
GPU: Intel UHD Graphics
RAM: 8 GB
Storage: HD de 512 GB
This environment was selected to ensure adequate performance during the application's development and testing.

3. EXPERIMENTS

3.1 Test Configuration

To evaluate the effectiveness of the application, tests were conducted in different investment scenarios to compare agent performance in recommending cryptocurrencies and investment strategies. The test setup included simulating queries from inexperienced investors seeking advice on investment opportunities based on updated data. Historical cryptocurrency datasets and market metrics (extracted from the CoinMarketCap API) were defined as the basis for generating recommendations. The application was tested in a controlled environment, with interactions centralized through the Orchestrator Agent to assess the accuracy of consolidated responses.

3.2 Performance Metrics

Performance metrics used to evaluate the application include:

- **Recommendation Accuracy:** Measured by the success rate of the investment suggestions provided by the system, comparing suggested results with actual market performance.
- **Response Time:** The average time required for the Orchestrator Agent to process a user query and consolidate the final response, considering data from CoinMarketCap and OpenAI APIs.
- **Personalization Across Scenarios:** The number of scenarios a user can suggest, allowing analysis based on various parameters such as return time, risk level, expected profits, etc.

3.3 Approach Comparison

To assess the application's effectiveness, two distinct approaches were tested:

- **Isolated LLM Agent:** In this approach, the system used only the natural language model (LLM), without integration with external sources or multi-agent orchestration. The LLM model interpreted user queries and generated recommendations based solely on its internal knowledge, without real-time data or contextual information.

- **LLM with Orchestrator and External Sources:** In this approach, the Orchestrator Agent managed the interaction between the LLM and the CoinMarketCap API. The orchestrator received the user's query and determined which specialized agent (CoinMarketCap or Web Search) would be most suitable to complement the LLM's response with updated and contextual data. This integrated model aimed to improve the accuracy and relevance of investment recommendations, offering a more dynamic and personalized solution for investors.

4. RESULTS AND DISCUSSION

The tests revealed clear differences between the two evaluated approaches. The strategy using only the standalone LLM model showed notable limitations in recommendation quality, especially in scenarios requiring updated market data. Suggestions from this approach tended to be more generic and, in some cases, outdated, reflecting the lack of external integration and absence of real-time context.

Conversely, the approach with the Orchestrator Agent demonstrated superior performance in most tests. The ability to integrate information from external APIs like CoinMarketCap allowed the system to generate responses more aligned with current market conditions. Recommendation personalization also stood out in this setup, as the system adapted its responses based on user-provided parameters such as risk tolerance, desired return timeframe, and specific interest in certain assets.

Furthermore, there was a significant improvement in recommendation accuracy, with the integrated system identifying investments more aligned with actual market behavior in the simulations. The inclusion of multiple specialized agents also helped reduce inconsistencies in responses, providing a more comprehensive and reliable view for inexperienced investors

Response time was another point of discussion. Although orchestration involves additional processing steps, the impact on latency was offset by the relevance and richness of the responses. Overall, the results indicate that the orchestrated architecture with external data sources is more suitable for financial recommendation applications, especially when the goal is to provide real-time, data-driven guidance.

Finally, the flexibility of the orchestrated solution proved valuable in accommodating different investor profiles, reinforcing its potential for real-world use where diverse scenarios and needs are constant.

5. CONCLUSION

Based on the experiments conducted, it was observed that the use of an Orchestrator Agent, together with updated APIs, led to significant improvements in the quality, relevance, and personalization of the recommendations provided to users. The comparison between the standalone LLM and the orchestrated system highlighted the limitations of approaches disconnected from the current market context, reinforcing the importance of continuous information updates in financial decision-support systems. Furthermore, the multi-agent architecture demonstrated flexibility in addressing different investor profiles, effectively adapting to varied scenarios.

This demonstrates the capability of the Orchestrator Agent approach, combined with the CoinMarketCap API and external sources, which shows notably superior performance, offering a highly effective user experience. The integration of real-time data sources allows the system to provide more accurate and contextualized investment recommendations, taking into account both the historical behavior of cryptocurrencies and current news and economic instabilities. This approach ensures that investors have access to relevant and up-to-date information, enhancing informed decision-making. Thus, the use of the orchestrator and the combination of specialized sources creates a seamless and high-quality experience, increasing user trust and satisfaction, and substantially improving outcomes in the cryptocurrency market.

Future perspectives include improving the user interface, expanding the dataset sources, and including new analysis parameters such as market sentiment and advanced technical indicators. These advances may further contribute to making the application a reliable, accessible tool aligned with the dynamics of the cryptocurrency market.

6. REFERENCES

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