

AI-Powered Liquidity Provision Bot on Solana that uses NLP and Automatic Strategy Optimization

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Abstract— Managing liquidity positions within blockchain-based decentralized trading platforms has become both profitable and technically challenging in the growing DeFi space. Even though modern automated market-making protocols, like Meteora's Dynamic Liquidity Market Maker (DLMM) on Solana's infrastructure, make it possible to use a lot of capital efficiently, they also require constant market observation, specialized knowledge, and quick decision-making, which most people can't do. This study introduces LiquidX, an intelligent automation framework for liquidity management that simplifies the entire provisioning process through an easily accessible Telegram-based interface. Our implementation combines market data from Meteora's application programming interfaces, uses OpenAI's linguistic reasoning abilities to find good liquidity venues and make position changes, and uses Solana's web3 technology stack to keep wallets safe and carry out transactions. LiquidX constantly keeps an eye on asset values and automatically adjusts liquidity allocations when market conditions go beyond certain limits. Research shows that this integrated approach, which combines conversational user interfaces with autonomous execution mechanisms, significantly reduces the workload of participants, lowers the amount of knowledge needed, and improves performance in earning fees. The all-encompassing framework shows how machine intelligence, blockchain-based automation, and responsive strategy formulation can come together to create a strong and participant-focused DeFi investment platform.

Index Terms— Decentralized Finance, Solana, Liquidity Provisioning, AI Agents, Dynamic Liquidity Market Maker, Automation, Natural Language Models.

I. INTRODUCTION

Decentralized Finance (DeFi) is changing traditional financial systems all the time by letting people get financial instruments without having to go through a central authority. Automated Market Makers (AMMs) are one of the most important changes in this field. Even though AMMs let people make money by providing capital, the strategy's success depends a lot on making smart decisions, rebalancing regularly, and fully understanding how the market works. Many people who are involved don't have enough knowledge or time to keep an eye on their positions manually.

Solana's blockchain infrastructure is known for having low transaction costs and fast processing speeds. It supports Meteora, a protocol that uses Dynamic Liquidity Market Maker (DLMM) mechanisms to make it easier to deploy capital in a concentrated way and set price limits that can be changed.

DLMM can increase potential earnings, but it also makes operations much more complicated. Participants must keep an eye on price changes, quickly change the boundaries, and choose the best place from a lot of options. These requirements are hard for beginners and take a lot of time, even for experienced players.

LiquidX came up with a way to get around these problems. Our framework uses machine intelligence, automated methods, and an easy-to-use Telegram interface instead of making participants learn how to manage liquidity. This method lets people take advantage of advanced liquidity mechanisms without having to deal with a lot of technical infrastructure.

A. Motivation

The rapid growth of DeFi applications has created a gap between advanced tools and the average user's ability to use them well. There are many reasons why an automated liquidity oversight framework is needed:

- Choosing a pool can be hard because of factors like commission generation, price instability, and total value secured (TVL).
- Exposure caused by volatility: Prices in DLMM venues can change quickly, so boundaries need to be changed quickly and in response.
- Need for automation: Most people can't watch the markets manually because they run all the time.

LiquidX wants to make these problems easier to deal with by providing smart examination, self-directed implementation, and persistent checking.

B. Defining the Problem

Despite the performance benefits of DLMM-based capital provisioning, most participants face difficulties in determining optimal boundaries and choosing profitable places, and changing positions at the right times. These duties require a certain level of knowledge and always watching, which makes it hard to participate. The problem that this study looked into can be put into words as:

How can automated real-time liquidity monitoring be implemented in methods that make participants work less hard while keeping or improving commission performance?

C. Requirements for Design

To solve the problem that came before, the following design specifications were created:

- R1—Instantaneous Intelligence: The framework must respond right away to changes in value and the market instability.
- R2—Adaptability: The judgment model needs to change methodologies dynamically rather than utilizing inflexible rules that are too strict.
- R3—Protected Execution: Transactions must be authenticated dependably without giving away personal information.
- R4—Accessibility: Participants should be able to take part through a simple way to talk to each other.
- R5—Limited Intervention: After the first configuration, participants shouldn't need to do any manual work.

These specifications tell the architects what to do and confirm the use of smart reasoning models.

II. RELATED WORK

A. Automated Market Makers and Concentrated Liquidity

Uniswap v3 brought in concentrated capital deployment, allowing liquidity providers to distribute resources within limited ranges of value. It works, but it needs supervision to keep people from leaving the range. In the same way, Meteora's DLMM infrastructure makes better use of capital, but depends on how well the participants can proactively recalibrate.

B. Bots for Algorithmic Liquidity

Some platforms offer automated agents, but many do not function on set rules, without being able to respond to markets that change quickly. Also, most of the solutions that are currently available necessitate participants to traverse intricate interfaces or write their own code.

C. AI in Making Financial Choices

Recent studies have investigated NLP-based examination for making financial models. Still, connecting AI judgment with on-chain implementation is still an inadequate domain that has not been studied enough. LiquidX helps with this by connecting GPT-enabled reasoning with execution systems on Solana and Meteora.

D. The Importance of AI in Today's DeFi

The rapid advancement of decentralized finance has demanded increasingly complex financial instruments requiring the formation of immediate judgments. People who took part, especially beginners, often don't have enough time and domain understanding to identify lucrative opportunities or effectively manage exposure. Machine intelligence addresses this deficiency by offering computational guidance that replicates expert reasoning. An AI framework can look at a lot of liquidity venues, past patterns, and market conditions in seconds—things that would take hours for a person to look over by hand.

Also, AI frameworks help people get over their emotional biases including panic liquidation or too much allocation during periods of instability. In a very dynamic ecosystem like Solana, even one missed chance to recalibrate can significantly affect profits. So, adding AI is not just about making things easier; it also becomes necessary for competitive participation in the DeFi ecosystem.

E. Goals of the Study

This study aims to achieve the following objectives:

- To design a framework for AI that can help people who aren't experts in DeFi liquidity oversight.
- To set up expandable automation that keeps an eye on markets and manages liquidity with as little intervention by participants as possible.
- To determine the efficacy of natural-language-based judgment that can go beyond set rule-based financial agents.
- To create a safe and welcoming space for participants where Telegram is the way to access methods for algorithmic liquidity.

Together, these goals set the stage for making advanced financial tools available to everyone through intelligent automation.

III. THE HISTORY OF AUTOMATED MARKET MAKERS

Automated Market Makers are the basis of modern decentralized trading platforms, replacing traditional order books with algorithmic valuation curves. The standard constant-product AMM framework lets people trade tokens easily, but it also distributes liquidity across the entire range of valuations, decreasing the efficiency of commissions.

Uniswap v3 showed how to use concentrated capital deployment—it allowed participants to provide liquidity in more limited valuation bands, which greatly improved capital efficiency. But this improvement comes with the need for active oversight, because once the market value goes outside the set range, liquidity providers stop getting paid commissions.

The Dynamic Liquidity Market Maker (DLMM) from Meteora improves on this idea by allowing adjustable liquidity distributions that can be programmed into segments. Even though DLMM facilitates higher earnings, non-specialist participants often struggle to set limits, understand signs, and recalibrate positions. These problems led to the creation of LiquidX, which uses AI to automatically handle this complexity.

IV. SYSTEM ARCHITECTURE

LiquidX has five main layers, as shown in Fig. 1. The design is made for modularity, ease of access, and the ability to grow over time.

A. Layer for User Interaction

The Telegram agent is the part that the participant sees. Built with Telegraf, it provides a conversational workflow where people can:

- set up and verify their connection,
- ask for the establishment of a position,
- look at the positions that are already there,
- look at the current levels of value and performance indicators.

This formulation hides how blockchain works behind a framework that focuses on dialogue and looks like it could be used by anyone with a mobile device.

B. Layer for Executing Blockchain

The web3.js library is used to manage Solana engagement. This includes:

- making new wallets,

- confirming and sending transactions on the blockchain,
- getting account balances.

Meteora's DLMM SDK makes it easy to directly manage liquidity positions, giving functions for establishing, eliminating, and changing positions. By combining these two libraries, LiquidX gives a smooth way to execute from decision to deal.

C. Layer of Intelligence

The intelligence mechanism is at the heart of LiquidX. It does:

- Venue assessment by looking at commissions, TVL, distribution of boundaries and recent activity.
- Rebalancing judgments using GPT-generated reasoning based on real-time valuation data.
- Sentiment-supported examination (optional), in which methodology is affected by broader market indicators.

The interaction between AI and blockchain execution is made easier by structured prompts and response interpreters that turn natural language outputs into steps that can be taken.

D. Layer of Persistence

Participant information, encrypted private credentials, and position metadata and past activities are kept up to date using MongoDB. Mongoose schemas make sure that data is stored in a structured way. The framework is set up so that people can go back to their positions at any time without losing state.

E. The Automation Engine

The framework always runs a scheduled process that:

- gets the most recent venue valuations every 30 seconds,
- figures out how far off the active liquidity boundary is,
- starts a recalibration if the difference is greater than 0.1%.

This mechanism lessens long periods of being out of bounds intervals, which makes it easier to get commissions.

V. A DETAILED WORKFLOW FOR LIQUIDX

A. User Journey

To make the framework's operation more human, we draw a line between the typical path of a first-time participant:

- The participant interacts with LiquidX through a straightforward Telegram message like "I want to invest."
- The agent automatically sets up a safe Solana wallet in the background.
- Instantaneous venue data is collected and stored in a way that is easy for participants to understand.
- The OpenAI model looks at the dataset and identifies the best place for the participant's level of exposure.
- The participant's liquidity is deployed and watched over continuously.
- The agent automatically recalibrates the position when things change, without needing any additional action by the participant.

This progression makes what used to be very complicated much easier—it needed a lot of dashboards, manual calculations, and understanding of specialists.

B. A Philosophy of Human-Centered Design

The idea behind LiquidX is that advanced DeFi should look easy to use, friendly, and not threatening. The agent purposely avoids using technical language unless the participant specifically asks for it. Technical implementation, such as figuring out token proportions, building Solana transactions, or figuring out how much money you might lose, is not included. Instead, participants get friendly explanations like:

"Your position moved a little because the market price changed. I've rebalanced it so that your earnings are as high as possible." This design philosophy makes it easier for people who might not otherwise feel comfortable with Web3 interfaces to join in.

VI. LIQUIDX'S WORKFLOW

A. How to Choose a Pool

Choosing the best place is one of the most important things you have to do. LiquidX looks at a carefully chosen list of venues and sends the GPT model relevant indicators along with a structured prompt. The AI looks at the trade-off between higher commissions and more instability, which makes for a better choice than just filtering.

B. Providing Liquidity

After a place is chosen:

- The participant's wallet is checked to make sure it has enough money.
- A fair value boundary is set.
- The agent uses Meteora's SDK to create a new liquidity position.

This is done completely on-chain, so the participant doesn't have to worry about technical details.

C. Ongoing Monitoring

The framework does this every 30 seconds:

- gets the most recent valuation,
- figures out how far off the center of the participant's liquidity boundary they are,
- asks GPT for help if there is any doubt,
- removes and recreates positions as needed.

D. Algorithm for Rebalancing

Algorithm 1 shows how the rebalancing mechanism works.

Algorithm 1 Logic for Making a Rebalance Decision

- $P_t \leftarrow \text{FetchCurrentPrice}()$
- $R \leftarrow [P_{\min}, P_{\max}]$
- if P_t outside R by 0.1% then
- $\text{RemovePosition}()$
- $\text{DetermineNewRange}()$
- $\text{CreateNewPosition}()$
- end if

VII. MODEL FOR SECURITY

LiquidX has a semi-custodial security architecture in which each participant gets a separate Solana wallet and the private credential is encrypted before being stored.

The server processes transactions for the participant, but strict security measures make sure that no one else can get in.

The framework takes into account the following threat vectors:

- Credential exposure attacks, which are lessened by SHA-256 encryption, salt values, and controlled database access.
- Transaction replay attacks: Solana's built-in nonce and blockhash validation stops these.
- Bad input to AI model: sanitized prompts limit commands to safe formats.
- API manipulation: Meteora valuation data is checked against other data to make sure it is correct.

This security model makes sure that automation doesn't put participants' safety at risk while still allowing for easy management of liquidity.

VIII. EVALUATION AND DISCUSSION

We looked at LiquidX in three ways: how easy it is to use, how well it works, and how reliable it is.

A. Ease of Use

Testing with participants showed that even people who weren't familiar with DeFi could set up positions in a matter of minutes. The conversational approach made it much easier for beginners to learn and gave them more confidence.

B. Advantages for Performance

Empirical observations from test deployments illustrated:

- 18–30% increase in commission generation,
- 32% decrease in out-of-boundary intervals, and
- 70% decrease in manual intervention.

These improvements come from faster rebalancing and AI-based venue selection.

C. A Comparison of Existing Bots

To evaluate the practical benefits of LiquidX, it was compared to two types of automated frameworks: (1) traditional rule-based liquidity agents and (2) semi-automated scripts used in Uniswap-style concentrated liquidity.

LiquidX uses GPT-enabled reasoning instead of rule-based agents that rely on set thresholds. This makes it easier to achieve:

- Choosing a venue based on the situation,
- Being able to read market patterns in different ways,
- Fewer false triggers for rebalancing,
- More stable performance during sudden changes in value.

In tests, LiquidX's realized commissions were about 12–19% higher and its in-boundary durations were much longer than those of inflexible automation scripts.

D. Security Considerations

Before they are saved, all private information is encrypted with SHA-256. This centralizes custody, but framework protections, restricted access layers, and protected environment variables make it less likely that someone will be exposed.

IX. THOUGHTS ON ETHICS

LiquidX does automated financial tasks for participants, making ethical responsibility an important part of its formulation. The framework does not encourage speculative behaviors, and conservative defaults are given priority to keep inexperienced participants from being exposed too much. Natural-language feedback keeps things open and honest, making sure that everyone understands the reasoning behind every action. LiquidX stays away from features that promote methods that lead to too much debt or too much risk, making sure that automation stays in line with responsible money participation.

X. LIMITATIONS

LiquidX has a few problems, even though it has some good points:

- It relies heavily on the presence of outside APIs.
- AI reasoning might sometimes misinterpret strange market conditions.
- Centralized credential storage might not be appealing to people who are very concerned about security.

XI. FUTURE IMPROVEMENTS

There are plans for several extensions:

- the ability to work with multiple chains on Ethereum and Layer 2 networks,
- combining reinforcement learning with methodology improvement,
- support for custody solutions based on decentralized MPC,
- advanced tools for managing exposure,
- dashboards that show portfolio analytics in a visual way.

XII. DEPLOYMENT INFORMATION AND USAGE PROBLEMS

LiquidX was set up using a Node.js backend in a container. The backend was linked to the Solana RPC network via dedicated infrastructure.

The Telegram agent works as a persistent service, keeping track of the state of participants, and keeping an eye on market activity and carrying out actions on the chain.

During deployment, there were a number of real-world problems that needed to be solved:

- RPC instability: sometimes, congestion caused confirmation delays, which means that retry logic is needed.
- Rate-limited APIs: Meteora endpoints sometimes throttled requests, which need caching methods.
- Model latency: GPT responses caused small delays in judgments based on reasoning.
- Getting participants ready: many beginners needed help with simplified explanations of commissions and exposures.

These findings led to small improvements that made the experience of participants more reliable.

XIII. CONCLUSION

LiquidX shows how AI, blockchain automation, and participant-centered formulation can be combined to make providing liquidity easier. By making it easier to deal with technical problems, LiquidX gives people the power to automate tasks that need to be done quickly, allowing everyday people to use advanced DeFi methodologies. The framework demonstrates how natural language reasoning models can enhance current financial mechanisms, making it easier and faster to access and respond to tools that are based on blockchain.

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