# Technical Design Document: AI-Powered Trading System for MetaTrader 4 (MT4) & Java AI Server

## 1. Introduction

This document outlines the technical design and architecture of the AI-powered trading system, which integrates MetaTrader 4 (MT4) with a Java-based AI trading server via ZeroMQ. The system enables automated trading using AI-generated signals.

### 1.1 Purpose

The purpose of this document is to provide a detailed technical overview of the system’s components, architecture, and interactions.

### 1.2 Scope

• Integration of MT4 with AI-powered trade execution  
• AI-based market prediction using LSTM/Reinforcement Learning  
• ZeroMQ communication between MT4 and the AI server  
• Trade execution and risk management strategies

## 2. System Architecture

[ MT4 Client (Expert Advisor) ] <---> [ ZeroMQ ] <---> [ Java AI Trading Server ]

### 2.1 Component Breakdown

|  |  |  |
| --- | --- | --- |
| Component | Technology | Function |
| MT4 Expert Advisor (EA) | MQL4 | Sends market data to the AI server & executes trades based on AI signals. |
| ZeroMQ Library (libzmq.dll) | C++ (Windows DLL) | Enables ZeroMQ messaging between MT4 & Java AI Server. |
| Java AI Trading Server | Java, DJL, RL4J | Receives market data, predicts trades, and returns trading signals. |
| Deep Learning Model | LSTM (Deep Java Library - DJL) | Predicts market trends using historical OHLC data. |
| Reinforcement Learning | RL4J (DeepLearning4J) | Adapts to market conditions and improves trading strategies. |

## 3. Data Flow Diagram

3.1 Trading System Workflow  
1. MT4 EA collects market data (OHLC, Volume, Spread, etc.)  
2. EA sends the data to the AI Trading Server using ZeroMQ  
3. AI Server predicts a trading signal (BUY/SELL)  
4. AI Server sends the signal back to the EA  
5. MT4 EA executes the trade automatically

3.2 Data Format (JSON Communication)

Market Data Sent from MT4 to AI Server:  
{  
 "Symbol": "EURUSD",  
 "Open": 1.1050,  
 "High": 1.1070,  
 "Low": 1.1030,  
 "Close": 1.1060,  
 "Volume": 100000  
}

AI Response (Trade Signal):  
{  
 "signal": "BUY"  
}

## 4. MT4 Expert Advisor (EA) Implementation

4.1 MT4 EA Responsibilities  
• Collects real-time market data  
• Sends data to the AI server via ZeroMQ  
• Receives and processes AI trade signals  
• Executes trades in MT4

## 5. Java AI Trading Server Implementation

5.1 AI Server Responsibilities  
• Listens for market data from MT4  
• Uses an LSTM model for price prediction  
• Uses reinforcement learning (RL) for decision-making  
• Sends trade signals back to MT4

## 6. AI Model Design

6.1 LSTM Model for Market Prediction  
• Uses historical OHLC data as input  
• Predicts next price movement to determine trade direction  
• Implemented using Deep Java Library (DJL)

6.2 Reinforcement Learning Model (RL4J)  
• AI learns from past trades to optimize strategies  
• Implements Q-learning for reward-based decisions  
• Adjusts trading behavior dynamically based on market performance

## 7. Trade Execution & Risk Management

7.1 Trade Execution Rules  
• AI sends BUY/SELL decisions based on predictions  
• EA places orders with Lot Size, Stop-Loss, Take-Profit

## 8. Error Handling & Debugging

Common issues and solutions:  
• `libzmq.dll not found` → Ensure DLL is placed in `MQL4/Libraries/` and restart MT4.  
• `No response from AI Server` → Verify Java server is running with `mvn exec:java`.  
• `Invalid JSON format` → Check if AI server sends correctly formatted JSON.  
• `MT4 EA not executing trades` → Ensure EA is attached, Auto Trading is enabled, and AI sends valid signals.

## 9. Performance Considerations

• Optimize LSTM models for fast inference  
• Use multi-threading in Java for handling multiple MT4 clients  
• Implement logging & monitoring for trade execution  
• Deploy AI models on cloud servers for live trading

## 10. Conclusion

This document provides a complete technical design overview of the AI-powered trading system integrating MetaTrader 4 with Java AI trading models. By leveraging ZeroMQ, LSTM deep learning, and reinforcement learning, the system offers a powerful, automated trading framework.