# Design and implementation of an automated Forex trading system based on dynamic strategy and custom technical indicators

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*In the rapidly evolving Fintech domain, automated trading systems play an increasing role in optimizing investments and risk management in financial markets, especially in foreign exchange (Forex). This paper presents the design, implementation, and evaluation of a novel Expert Advisor (EA) named PicoDyna on the MetaTrader 4 platform using MQL4. PicoDyna is built upon a trend-following strategy combined with adaptive components: it leverages multiple technical indicators (RSI, CCI, EMA, and Coral) and a dynamic martingale-like position sizing mechanism (LotExponent) with a volatility-based order spacing (dynamic PipStep). Advanced risk management features, including trailing stops, time-based exits, and equity drawdown protection, are integrated to enhance the system's robustness. We evaluate PicoDyna with one-year historical backtests on two distinct instruments (EUR/USD and XAU/USD) on H1 timeframe. The results demonstrate stable performance, with a high win rate and profit factor >1.8 on both instruments, and effective drawdown control (max <17%). The EA exhibits adaptability to different market conditions, yielding consistent gains in trending markets while limiting losses during sideways or volatile periods. This study contributes a modular EA framework that can adapt to market volatility and provides a basis for further research in applying AI and machine learning to automated trading.*
*Keywords:* Fintech, Forex, Algorithmic Trading, Expert Advisor, MetaTrader, Technical Indicators, Martingale, Risk Management, MQL4.

# Разработка и внедрение автоматизированной системы торговли на рынке Форекс на основе динамической стратегии и пользовательских технических индикаторов

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*В быстро развивающейся сфере Fintech автоматизированные торговые системы играют все большую роль в оптимизации инвестиций и управлении рисками на финансовых рынках, особенно на валютном рынке (Forex). В данной статье представлены разработка, реализация и оценка нового экспертного советника (EA) под названием PicoDyna на платформе MetaTrader 4 с использованием MQL4. PicoDyna построена на стратегии следования за трендом в сочетании с адаптивными компонентами: она использует несколько технических индикаторов (RSI, CCI, EMA и Coral) и динамический механизм определения размера позиции по типу мартингейла (LotExponent) с интервалом между ордерами на основе волатильности (динамический PipStep). Расширенные функции управления рисками, включая трейлинг-стопы, выходы на основе времени и защиту от просадки капитала, интегрированы для повышения надежности системы. Мы оцениваем PicoDyna с помощью годовых исторических бэктестов на двух различных инструментах (EUR/USD и XAU/USD) на таймфрейме H1. Результаты демонстрируют стабильную производительность с высоким процентом выигрышей и профит-фактором >1,8 на обоих инструментах, а также эффективным*

*контролем просадки (макс. <17%). Советник демонстрирует адаптивность к различным рыночным условиям, обеспечивая последовательный прирост на трендовых рынках, ограничивая потери в периоды бокового движения или волатильности. Это исследование вносит вклад в развитие модульной архитектуры советников, способной адаптироваться к волатильности рынка, и создаёт основу для дальнейших исследований в области применения искусственного интеллекта и машинного обучения в автоматизированной торговле.*

*Ключевые слова:* Fintech, Forex, алгоритмическая торговля, экспертный советник, MetaTrader, технические индикаторы, мартингейл, управление рисками, MQL4.

## Introduction

The foreign exchange (Forex) market is the world's largest financial market with high liquidity and daily turnover around $5 trillion. This scale provides significant profit opportunities, but also considerable risk due to volatility. Algorithmic trading refers to using computer programs to automatically execute trades based on predefined conditions. In the Forex market, such programs are commonly known as Expert Advisors (EA), typically implemented on platforms like MetaTrader using MQL4/5. An EA can operate 24/5 without human intervention, systematically analyzing price data and managing orders. According to IEEE definitions, an EA is an automated trading program that enables the automation of analytical and trading activities in the forex market. By removing human factors (emotions, fatigue, reaction time), EAs aim to improve trading consistency and effectiveness [1].

However, many existing EAs have limitations. Common issues include lack of adaptability to changing market conditions, over-reliance on single indicators or fixed strategies, and suboptimal risk management (especially in extended ranging markets or during sharp reversals) [2], [3]. Traders often find that a strategy optimized for a trending market fails in a volatile or sideways phase. Moreover, some EAs employ naive martingale or grid strategies that can yield high profits in calm periods but risk catastrophic losses when trends sharply reverse. Risk management and strategy flexibility are thus critical aspects often requiring improvement [4], [5], [6].

PicoDyna is proposed to address these gaps. The goal of this research is to develop a more flexible and effective EA that adapts to market dynamics and incorporates robust risk controls. PicoDyna integrates: 1) enhanced technical indicators (RSI, CCI, Coral trend indicator, EMA) to capture diverse market signals; 2) a dynamic trade placement and sizing strategy where both position size and spacing adapt to volatility; and 3) advanced risk management tools including trailing stops, time-out exits, and equity protection stops. By combining trend-following and mean-reversion logics with a controlled martingale-like money management, we aim for an EA that can sustain performance across varying market regimes.

The remainder of this paper is organized as follows: the next section reviews related work on algorithmic trading strategies and similar EAs. Then, PicoDyna's system architecture, indicator logic, and trading algorithm are described. After that, we present the experimental setup and backtesting results on EUR/USD and XAU/USD with discussion. The final section concludes the paper and outlines future developments.

## Related Work

Automated trading has been extensively explored in both industry and academia [7]. Classic trading literature emphasizes disciplined strategies and technical analysis tools – for instance, Elder's work [8] underlines the importance of systematic approaches and risk management, while Murphy [9] provides an overview of technical indicators like moving averages, RSI, and CCI that are fundamental to many strategies. Such indicators are widely used to identify trends or overbought/oversold conditions. Many algorithmic systems build upon these indicators; for example, moving-average crossovers and oscillators are common in EAs to signal entries [9].

In academic research, numerous studies have proposed EAs or automated strategies for Forex. Chourmouziadis et al. [10] developed an intelligent fuzzy trading system that integrates four medium-term technical indicators. Their approach demonstrates how combining multiple indicators within a rule-based logic can enhance decision-making accuracy and portfolio performance. Similarly, other researchers have explored strategies incorporating trend-following signals with adaptive position sizing mechanisms [11]. These systems often aim to retain the profitability potential of techniques like martingale while reducing associated risks. For instance, improved martingale systems cap the number of successive trades and use equity stops to prevent runaway loss sequences.

Machine learning has also been introduced to enhance the performance of Expert Advisors (EAs). M. A. H. Bin Ismail et al. [12] applied Japanese candlestick pattern recognition combined with a Support Vector Machine (SVM) model

to predict market movements and automate trading decisions. Their approach aims to reduce emotional bias and improve decision-making consistency. Such machine learning-based systems are capable of capturing complex market patterns but typically require extensive training data and introduce additional computational complexity [13]. Furthermore, recent research emphasizes the integration of multiple data sources—technical indicators, historical patterns, and adaptive algorithms—as a strategy to improve the overall robustness and profitability of automated trading systems [13].

Our work builds on this literature by combining multiple technical indicators with a dynamic position sizing scheme. The use of a volatility-based PipStep (distance between orders) in PicoDyna provides adaptability that fixed-grid EAs lack. Previous systems have either used static grids or simple ATR-based stops; by explicitly computing order spacing from recent high-low ranges, our EA adjusts to market volatility in real time. Furthermore, we integrate several risk management layers (trailing stop, time-out, equity stop) which, as suggested by best practices [8], [9] are essential for long-term sustainability. This multi-faceted approach (trend-following + mean-reversion + adaptive martingale + strict risk control) is, to our knowledge, a novel combination in an MT4 EA implementation. PicoDyna thus represents an advance in designing robust, self-adapting trading algorithms.

## Methodology

*A.System Architecture and Components*

PicoDyna is implemented as an MQL4 Expert Advisor with a modular architecture. The EA's operation flow is illustrated in Figure 1, which outlines the main functional modules and decision process. The EA continuously cycles through these stages: (1) Signal Analysis – analyze price data and indicators; (2) Entry Decision – decide whether conditions warrant opening a new trade; (3) Order Placement – execute or place pending orders as needed; (4) Monitoring and Adjustment – manage open positions (modify stops, track time); and (5) Trade Closure – exit positions based on take-profit, stop-loss, time-out or equity-stop conditions.



*Fig. 1. Flowchart of PicoDyna's trading logic. The EA analyzes indicator signals and price levels, decides on entry, places orders (market or pending), then continuously monitors positions with trailing stop and risk controls, eventually closing trades per exit rules*

The EA's code is structured into several modules corresponding to the above stages: an initialization module (one-time setup of parameters and indicator handles), a signal computation module (calculating indicator values each tick/bar), a trade logic module (evaluating entry/exit conditions), a pending order module (for placing buy stop/sell stop orders to optimize entry price), a position management module (adjusting trailing stops, etc.), and a global risk management module that monitors overall account equity and exposure. This separation of concerns makes the system easier to maintain and extend.

*B. Technical Indicators and Entry Signals*

To improve decision reliability, PicoDyna combines multiple indicators and price filters for trade signals:

Trend-Following Indicators: A standard Exponential Moving Average (EMA) and the Coral Indicator (a smoothed trend indicator) are used to gauge the primary trend. When price is above/below these trend filters, it indicates a bullish/bearish bias. The Coral indicator, in particular, responds well to trend changes and helps avoid false signals during choppy periods.

Momentum/Oscillator Indicators: The EA uses Relative Strength Index (RSI) and Commodity Channel Index (CCI) to detect overbought/oversold conditions. RSI thresholds (e.g. >65 for overbought, <35 for oversold) and CCI levels (e.g. ±100, ±200 extremes) define when price may be stretched away from its mean. These conditions often precede reversals or pullbacks, so they provide counter-trend entry opportunities when aligned with a broader trend context.

Dynamic Support/Resistance Levels: The strategy computes dynamic support (S1, S2…) and resistance (R1, R2…) price levels based on recent highs and lows (using parameters kr1, kr2, ks1, ks2, etc.). These act as adaptive thresholds: for example, a long trade signal is stronger when price is near a calculated support level and indicators confirm an oversold condition in an uptrend [3],[9].

Entry logic: A new position is considered only when all requisite conditions align. The following Table 1 summarizes entry criteria for Buy and Sell signals.

*Table 1*

**Entry Logic Conditions for Buy and Sell Signals**

| Condition | Buy Entry | Sell Entry |
|---|---|---|
| Price relative to Support/Resistance | At or below Support (e.g., S2) | At or above Resistance (e.g., R2) |
| RSI condition | RSI < 65 (not overbought) | RSI > 35 (not deeply oversold) |
| CCI condition | Low CCI (oversold) | High CCI (overbought) |
| Trend filter (Coral/EMA) | Uptrend or neutral | Downtrend or neutral |
| Order type | Buy Stop above price to confirm momentum | Sell Stop below price to confirm momentum |

By requiring confluence of trend and oscillator signals, PicoDyna filters out many false signals that a single-indicator EA might take. Also, instead of immediately executing at market, the EA often uses pending orders (buy stop or sell stop) just beyond the trigger level. This ensures that the price is indeed moving in the anticipated direction (e.g., a few pips above the identified support for a buy) before entry, thus avoiding entries on temporarily touching a level without momentum follow-through.

*C. Dynamic PipStep – Volatility-Based Order Spacing*

A key innovation in PicoDyna is its dynamic PipStep mechanism for spacing grid orders. Traditional grid or martingale EAs use a fixed distance between successive orders, which can be suboptimal – too small in volatile markets (leading to overtrading) or too large in calm markets (underutilizing margin). PicoDyna computes PipStep based on recent market volatility:

$$\text{PipStep} = \left\lfloor \frac{H_{\text{lookback}} - L_{\text{lookback}}}{\text{DEL} \times \text{Point}} \right\rfloor,$$

where $H_{\text{lookback}}$ and $L_{\text{lookback}}$ are the highest high and lowest low over a lookback window (parameter Glubina, e.g. 24 bars), DEL is a volatility divisor (e.g. 3), and Point is the symbol's pip unit. This calculation (executed on each new order cycle) yields a PipStep in pips that expands or contracts with the trading range. For example, if recent high-low range is 60 pips and DEL=3, PipStep becomes 20 pips; in a quieter period with range 30 pips, PipStep would be 10 pips. This adaptive spacing helps the EA scale into positions optimally: wider spacing in volatile conditions avoids clustering too many orders during whipsaws, while tighter spacing in stable conditions maximizes the use of available margin for profit.

When PicoDyna opens a trade and market moves against it, additional orders (add-ons) are placed at intervals of one PipStep apart (up to a limit). These could be original direction orders or counter-trend stop orders in case of strong adverse

movement (an emergency measure to catch a breakout reversal). The dynamic PipStep ensures these subsequent orders are placed at sensible price intervals reflecting current volatility, rather than a arbitrary fixed gap.

*D. Smart Martingale Position Sizing*

To capitalize on partial reversals and recover from drawdowns, PicoDyna employs a controlled Martingale strategy for position sizing. Rather than a full doubling, it uses a configurable lot size multiplier LotExponent. Each successive trade (in the same sequence when the previous is in loss) has its lot size = previous lot * LotExponent. For example, if LotExponent = 1.1 and the initial trade size is 0.1 lots, the next added trade would be 0.11 lots, then ~0.12 lots, etc. This gradual increment is less aggressive than classic Martingale, reducing risk. We also cap the maximum number of open trades (MaxTrades, e.g. 10) to prevent unlimited averaging down. An additional parameter LotExponentBu (for "burst" orders) is applied if the EA places special breakout pending orders; this allows a slightly different scaling for those emergency orders (e.g. LotExponentBu = 1.2).

This "smart" martingale approach helps in *loss recovery*: if the market eventually retraces in favor of the positions, the larger volume on later trades helps cover the earlier losses, allowing the basket of trades to close in net profit once a take-profit level is hit. Importantly, PicoDyna sets a uniform take-profit (TP) for all trades in a sequence at a price calculated to yield a target profit (e.g., ProfitTarget per trade or per sequence). All orders in the sequence close simultaneously when that price is reached. This prevents "legging out" unevenly and simplifies profit calculation.

Risk control is paramount: if the sequence reaches MaxTrades or if losses accumulate, the EA will not open new trades indefinitely. Additionally, as described next, global safety stops (time-based or equity-based) can trigger to halt the sequence.

*E. Trade Management and Risk Control*

PicoDyna integrates several risk management mechanisms to protect against adverse market moves:

Stop Loss (SL) and Take Profit (TP): Each order has an initial SL and TP based on strategy settings. In this EA, SL is relatively wide (e.g. 500 pips) given the intent to manage trades via the grid strategy, while the TP for individual trades might be moderate (e.g. 70 pips) or dynamically adjusted. More importantly, the EA computes an overall exit point for the entire position sequence (as mentioned above) so that when the average position is in profit by a certain amount, all trades are closed.

Trailing Stop: Once a trade (or the overall position) becomes profitable by at least a threshold (TrailStart, e.g. 10 pips), a trailing stop is activated to lock in profits. The EA uses a custom routine TrailingAlls() that moves stop-loss orders closer as price advances favorably. For example, with TrailStart=10 and TrailStop=10, when a trade is +10 pips, the SL is moved to breakeven; for each further 10 pips gain, the SL is moved 10 pips behind current price. This applies to all open trades, effectively securing partial profits and reducing risk of giving back gains.

Time-out Exit: Markets can sometimes stagnate, and holding positions too long increases exposure. PicoDyna includes a MaxTradeOpenHours parameter (e.g. a few hours up to a day). If a trade remains open longer than this allowed duration, the EA will close it to avoid overnight/event risks. This prevents trades from hanging indefinitely in sideways markets.

Equity Stop (Drawdown Protection): A crucial safety feature is the Total Equity Risk limit. For instance, if TotalEquityRisk = 20%, the EA will monitor the account's equity drawdown. If the unrealized loss on all open positions for the EA's symbol exceeds 20% of the account balance (or a preset absolute amount), it will immediately close all positions on that symbol to prevent further loss. This acts as a hard stop to contain worst-case scenarios (e.g., a runaway trend against a grid of trades). In our tests, this was triggered a few times on XAU/USD in extreme moves, cutting off losses at ~16% drawdown, after which the EA stood aside until conditions improved.

Collectively, these risk controls ensure that while PicoDyna can leverage a martingale-like strategy for recovery, it does so in a bounded way. The EA also logs each action, which aids in debugging and verifying that, for example, a timeout or equity stop event occurred as expected rather than a system error. Notably, no system crashes or anomalies were observed in testing – the EA handled edge cases (like hitting MaxTrades or equity stop) gracefully, indicating a reliable implementation.

## Results and Discussion

*A. Backtesting Setup*

To evaluate PicoDyna's performance, we conducted backtests using MetaTrader 4's Strategy Tester on two instruments with distinct market characteristics: EUR/USD (a major currency pair known for relatively stable trends and high liquidity) and XAU/USD (Gold) (a commodity pair with higher volatility and sensitivity to news). Both were tested on the H1 timeframe (hourly bars) over a one-year period (1 January 2023 to 31 December 2023). The initial deposit was $10,000 for each test, with no additional deposits/withdrawals.

EA Parameters: The EA was configured identically for both symbols (to test its adaptability without symbol-specific tuning). Key parameters are: initial lot size = 0.1; LotExponent = 1.1 (increment 10% per added trade); LotExponentBu = 1.2 for any breakout stop orders; MaxTrades = 10; TakeProfit = 70 pips (per trade, though sequence TP is dynamic as

described); StopLoss = 500 pips; TrailStart = 10 pips, TrailStop = 10 pips; TotalEquityRisk = 20%; Glubina = 24 (lookback bars for volatility); DEL = 3. These values were chosen to balance risk and reward: e.g., 10 trades max * 0.1 lots initial allows up to 1.0 lot total exposure, and 20% equity stop limits worst-case loss to $2,000. Other strategy-specific thresholds (RSI, CCI levels, support/resistance factors $kr, ks$) were predetermined from prior optimization and kept constant.
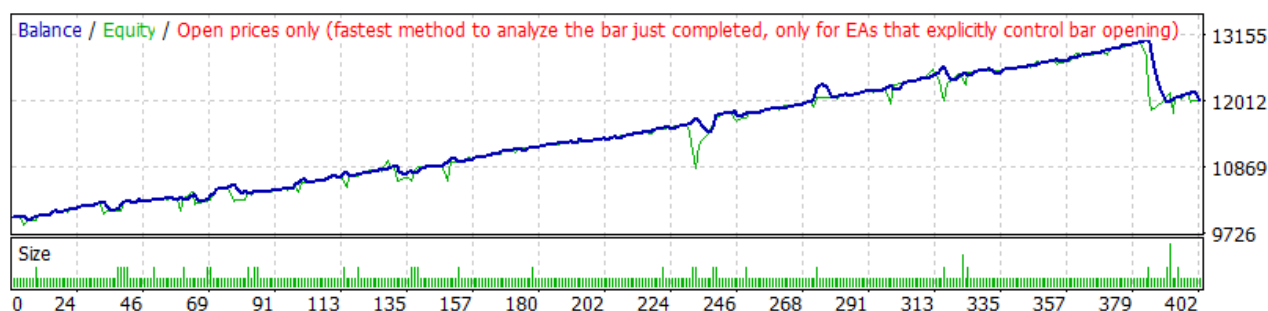
*B. Performance on EUR/USD*



*Fig. 2. Balance and equity curve for PicoDyna on EUR/USD (H1, 2023). The blue line is balance and green line is equity. PicoDyna achieved steady equity growth with limited drawdowns on this pair*

On EUR/USD, PicoDyna executed 429 trades over the year. The EA was active throughout trending periods and even during mild ranges, though it became more selective in prolonged sideways markets (reflected by flat equity segments). Key results are summarized as follows:

- Win rate: 78.2% of all trades were closed at profit. This high win ratio is typical for strategies that employ averaging-down (martingale) – losing sequences are often eventually closed in profit. However, it also indicates the EA's entry logic was accurate in identifying profitable opportunities most of the time.
- Net profit: +$3,540, which is a +35.4% return on the $10k account. This averages to roughly $295 profit per month. While modest in absolute terms, the growth was consistent and without major equity swings.
- Maximum Drawdown: 9.8% (approximately $980). This drawdown is relatively low, demonstrating effective risk control on EUR/USD. The largest equity dip occurred during a period of sharp counter-trend moves in mid-2023, during which the EA hit its equity stop once. Equity Stop Triggered: 1 time – meaning on one occasion the EA closed all EUR/USD positions to cap losses. After that, it resumed trading normally. The single trigger indicates that most of the time the EA managed to recover without needing the hard stop.
- Profit factor: Approximately 1.8+, meaning total gross profit was over 1.8 times the gross loss (the Strategy Tester reported Profit Factor > 1.8). This reflects a favorable risk-reward balance given the high win rate and controlled losses.

The equity curve (Fig. 2) shows a steadily rising balance (blue) with small drawdowns (distance between green equity line and blue balance line). Notably, in both uptrends and downtrends of EUR/USD, the EA performed well, capturing profits. During long flat periods (e.g., late Q2 2023), the EA opened fewer trades as conditions didn't trigger the robust entry criteria, resulting in nearly flat equity – a prudent behavior preserving capital when the strategy had low conviction. Overall, PicoDyna demonstrated stable performance on EUR/USD, with smooth equity growth and minimal volatility in account balance.

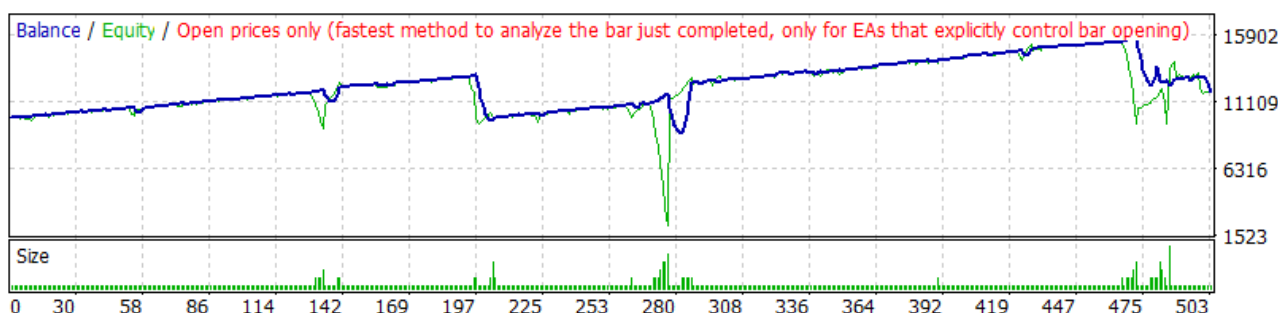*C. Performance on XAU/USD (Gold)*



*Fig. 3. Balance and equity curve for PicoDyna on XAU/USD (H1, 2023). Gold's higher volatility led to larger equity swings and occasional deep retracements, but the overall balance trend is upward*

On the more volatile XAU/USD, PicoDyna took 528 trades in 2023. Gold's price swings provided more frequent trading opportunities, but also tested the EA's risk limits more aggressively:

- Win rate: 74.6%, slightly lower than EUR/USD but still high. The EA encountered a few more losing sequences on gold due to its volatility. Nevertheless, nearly three out of four trades were profitable.

- Net profit: +$6,720 (+67.2% on initial capital), about double the absolute profit from EUR/USD. Monthly average profit was ~$560. The higher profit is attributed to gold's larger price moves – when the EA's strategy was on the right side of a trending move, it accumulated substantial gains. For example, strong trends in mid-2023 saw the EA build positions that were closed for large net profits.

- Maximum Drawdown: 16.4% (~$1,640). As expected, drawdown on gold was higher. The equity curve (Fig. 3) shows a few sharp dips. These correspond to episodes where gold's price quickly moved against the EA's positions (often on news spikes), and multiple levels of the grid were filled. In these cases, the Equity Stop was triggered to limit losses. Equity Stop Triggers: 3 times during the year on XAU/USD. Each time, the EA halted trading after cutting losses at ~15% drawdown, then re-entered when favorable conditions returned. This proactive loss containment prevented what could have been far larger drawdowns (without equity stop, the martingale could have doubled down further and lost much more during an extended adverse trend). After each stop-out, the EA recovered the losses in subsequent trades as trends reasserted.

- Profit factor: Despite the higher drawdowns, profit factor remained >1.8 (approximately in the same range as EUR/USD), indicating that the magnitude of winning trades well outweighed the losses from the few stop-out events. The EA's ability to ride strong gold trends contributed to a robust overall profitability.

From Fig. 3, we observe a generally upward balance line but with visible jagged equity fluctuations. There are periods where equity (green) drops significantly below balance – notably around trade count 140–170 and 270–300 on the x-axis – reflecting drawdowns. These were precisely the times the equity stop kicked in (seen as sudden balance drops as well). After each, the EA resumed with a fresh sequence, and the equity quickly recovered to new highs, resulting in a higher final balance compared to EUR/USD. The results on XAU/USD show that PicoDyna's strategy can handle high volatility to an extent, but with more risk. It "trades off" a higher drawdown for higher return. The EA exploited Gold's trending phases effectively (yielding nearly double the return of EUR/USD), but traders should be aware of the greater equity swings. In practice, one might use more conservative settings for very volatile assets (e.g., smaller LotExponent or lower equity risk % for gold).

*D. Comparative Analysis and Discussion*

The backtest outcomes across EUR/USD and XAU/USD highlight how market characteristics affect PicoDyna's performance. EUR/USD, being more stable, allowed the EA to maintain a very high win rate and low drawdown – ideal for a smooth equity curve [14]. The adaptive PipStep kept the trade spacing appropriate, and the EA often didn't reach the MaxTrades limit on EUR/USD, meaning it rarely needed to fully deploy the martingale sequence. In contrast, XAU/USD's volatility meant the EA more frequently utilized the maximum number of trades and hit safety stops. Yet, the fact that the profit factor remained around 1.8 for both suggests that the strategy's fundamental edge held true in both scenarios: it was able to generate nearly twice as much gross profit as gross loss on both instruments.

One notable observation is the effect of sideways markets. During long ranging periods with no clear trend, the EA's entry criteria (which require a trend or extreme) led to fewer trades. This was seen in parts of the EUR/USD test (and some range-bound months in gold as well). Consequently, monthly profit in those periods was lower. This is a reasonable trade-off, as forcing trades in choppy markets often yields false signals. The EA essentially "stayed on the sidelines" during unfavorable conditions, preserving its win rate and awaiting better opportunities. This behavior aligns with the design goal of adaptability.

The risk measures implemented proved effective. The trailing stop contributed to locking in incremental gains – for instance, several long gold trades benefited from trailing the stop as gold prices surged, capturing more profit than a fixed TP would. The time-out feature closed a few trades that stagnated (especially on EUR/USD, when a minor position was open for more than 8 hours with minimal movement, it was closed near break-even), thus freeing margin for new trades. Most importantly, the equity stops, albeit hit a few times, prevented large losses. Without it, those losing streaks on XAU/USD could have doubled the drawdown or worse. Thus, in live trading, these controls would be vital to protect the account.

*Reliability:* Throughout the tests, PicoDyna did not encounter technical issues. All orders and closures were executed as intended. There were no "missed" stop losses or runaway positions – whenever conditions met, the EA's logic (time-out or equity stop) closed the trades reliably. This indicates a robust implementation that can be trusted to operate unattended.

In summary, the results validate that PicoDyna meets its design objectives: it adapts order placement to market volatility, combines multiple signals to achieve a high probability of success, and manages risk through layered controls. The EA performed strongly on two very different instruments with the same settings, suggesting good generalizability. For traders, PicoDyna could be used on a portfolio of symbols, but one should adjust risk parameters to each symbol's nature (as seen, gold required enduring higher drawdown for higher returns). Additionally, long-term forward testing and optimization could further improve performance, but the current one-year backtest provides a solid proof-of-concept of the EA's capabilities.

## Conclusion and Future Work

We have developed and evaluated PicoDyna, an automated trading system (Expert Advisor) for Forex, built in MQL4 on MetaTrader 4. PicoDyna integrates a trend-following strategy with mean-reversion signals and a smart martingale mechanism, enhanced by dynamic volatility-based adjustments and rigorous risk management. The scientific contribution of this work lies in demonstrating how adaptive strategies (like dynamic PipStep and controlled lot scaling) can yield stable trading performance across different market conditions. The backtest results on EUR/USD and XAU/USD showed that PicoDyna achieved high win rates and attractive returns (35–67% annual gain) while keeping drawdowns in check (under 20%). These outcomes highlight the advantages of algorithmic trading in fully automating the trading process, removing emotional decision-making, and reacting swiftly to market changes.

Nevertheless, there are limitations to acknowledge. PicoDyna's strategy, like all grid/martingale approaches, can still face challenges in extreme market scenarios (e.g., a prolonged trend with no pullbacks). We mitigated this with equity stops and trade limits, but the risk is not eliminated. Additionally, the evaluation was based on historical data; real-time performance may differ, especially under high-impact news events or changing market regimes. No comparison to other EAs or benchmarks was made in this study – an area for future analysis could be to compare PicoDyna's performance with, say, a pure martingale EA or a single-indicator EA to quantify improvements.

**Future Work:** There are several directions to extend this research:

*Machine Learning Integration***:** Incorporate AI techniques to enhance decision-making. For example, using supervised learning or reinforcement learning to adjust the EA's parameters or to filter signals could improve adaptability. A sentiment analysis module could be added to gauge market sentiment from news or social media, providing an additional layer of confirmation (or avoidance) for trades beyond technical indicators [15],[16].

*Multi-Asset and Portfolio Testing:* Thus far, PicoDyna was tested on Forex (currency) and a commodity (gold). Future experiments could apply the EA to other asset classes such as cryptocurrencies, stock indices, or different Forex pairs. This would validate the strategy's robustness and might involve tuning the PipStep divisor or indicator thresholds for assets with different volatility profiles.

*Migration to MQL5/Advanced Platforms:* Upgrading the EA for MetaTrader 5 or other trading platforms (with API access) can be explored. This could improve execution speed and allow testing on more complex scenarios (MT5 provides more backtesting options like multi-currency testing and higher modeling precision).

*User Interface and Parameter Optimization:* Developing a graphical user interface for PicoDyna would help traders adjust parameters easily. An interactive panel could allow on-the-fly changes to risk settings or enable/disable certain sub-strategies, making the tool more accessible to non-programmers. Additionally, implementing an auto-optimization routine for key parameters (e.g., using MT4's optimization or custom scripts) could periodically re-tune the EA as market conditions evolve.

By enhancing PicoDyna with the above features, we aim to create a more *intelligent and versatile trading system*. The positive results obtained so far encourage further research and real-world forward testing. Ultimately, this work contributes to the ongoing development of reliable automated trading strategies in Forex – bridging traditional technical analysis with adaptive algorithms and setting the stage for integrating AI-driven insights into algorithmic trading.

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