

Zelta Labs Final Evaluation Report (Team_73)

This report includes the final work done
of the Zelta Labs PS as part of Inter IIT Tech Meet 13.0 by **Team_73**.

CONTENTS

I	Introduction	3
II	Data Analysis	3
III	Strategy Overview	3
IV	Individual Strategy Overview BTC	4
IV-A	Burning Phoenix(for BTC)	4
IV-A1	Overview	4
IV-A2	Core Concept	4
IV-A3	Challenges	5
IV-A4	Solution	5
IV-A5	Risk Management	5
IV-A6	Important	6
IV-A7	Correlation/Key Features	6
IV-B	Technical Indicators Integration(for BTC)	6
IV-B1	Overview	6
IV-B2	Core Concept	6
IV-B3	Risk Management	6
IV-B4	Key Features	6
IV-C	Corroborative Integration (for ETH)	7
IV-C1	Overview	7
IV-C2	Core Concept	7
IV-C3	Risk Management	7
IV-C4	Key Features	7
IV-D	INDICATOR MAXING(for ETH)	7
IV-D1	Core concept	7
IV-D2	Challenges	8
IV-D4	Key Features/Indicators	8
IV-E	Temporal Fusion Transformer (for ETH)	8
IV-E1	Overview	8
IV-E2	Core Concept	8
IV-E3	Risk Management	9
IV-E4	Key Features	9
IV-E5	Challenges and Future Scope	9
IV-F	Kalman Filter(BTC))	10
IV-F1	Overview	10
IV-F2	Core Concept	10
IV-F3	Risk Management	10
IV-G	Kalman Filter(ETH))	10
IV-G1	Overview	10
IV-G2	Core Concept	10
IV-G3	Risk Management	10
V	Performance Metrics	11
V-A	Master Alpha (for ETH)	11
V-B	Master Alpha (for BTC)	11
VI	Plots	12

VII	Portfolio Manager	14
	VII-1 How It Works	14
	VII-2 Choosing optimal change period	14
VIII	Unique Approach and Innovation	14
	VIII-A Plot for Trend Analysis	14
	VIII-B Difference from Traditional Methods	14

I. INTRODUCTION

This report describes our efforts and strategy development for trading the BTC/USDT and ETH/USDT. Our Team aims to create a robust algorithm that leverages Market Indicators and extra Innovative tools to capitalize on Trends and Volatility. We are employing unique Data-driven techniques to enhance our Interpretability in trading accuracy and manages risk effectively. Our team has divided tasks by timeframes, working on strategies from minute-level to monthly scales to capture market trends across different trading horizons. This report outlines our current progress, unique methodologies, and the development process for achieving competitive performance.

II. DATA ANALYSIS

Current Status on BTC and ETH

A comprehensive analysis was done on the various datasets provided which gave meaningful results for identifying the different anomalies in the data. Below are the results for 1-day BTC dataset.

Kalman Filters: The Kalman Filters help smoothen price fluctuations and noise in the data which is useful for identifying periods of volatility and also in identifying trends. From Sep 2019 to Apr 2020, the plot with its minor fluctuations hints towards a period of **lower volatility** and no significant trends. The plot is oscillating around the zero line which indicates the presence of **mean reversion**. The region from Apr 2020 to Aug 2022 is highly fluctuating and volatile with significant up and down trends. The volatility again decreases towards the end and is followed by gradual recovery.

Z-Score: The Z-Score is useful for identifying outliers in the data and hence significant information about **entry** and **exit** points can be obtained. For the given dataset, the plot had frequent crossings over the the mean-line which indicates the presence of **mean-reversion** in the data. The plot stayed on one side of the mean-line for considerable low durations of time, hinting at the presence of **short trends**.

Seasonal Decomposition: On decomposing the data into trend, seasonal and residual component, critical knowledge can be obtained about the presence of seasonality and trends in the data. The scale of the seasonal component is found to be much shorter than that of the trend which solidifies the **absence** of any **seasonality** in the data.

MACD Gaussian Smoothing: MACD is useful for identifying potential **trend reversals** in the market. Combined with Gaussian Smoothing noise is reduced, helping to highlight overall trends and reduce fluctuations in the histogram. The plot for this was again found to be fluctuating above the zero-line, indicating **absence** of **long trends**.

Dickey-Fuller Test: A Dickey-Fuller Test is used to check if the given time series is stationary or not. The **p-value** was much higher than the critical value of 0.05 which makes doesn't allow to reject the null hypothesis. Thus there is **not** enough evidence to state if the data is **stationary**.

Similarly an analysis on 1-day ETH data gave insights into the **co-integration** present in BTC and ETH data.

Kalman Filters: Identical to the BTC data, there were periods of higher **volatility** in the **middle** while the corners were relatively more stable. The plot repeatedly oscillated along the zero-line indicating at the presence of **mean reversion** in the data.

Z-Score: The plot was over the line for considerable amounts of time indicating at the presence of short trends as well as multiple crossings over the zero-line verified the presence of mean reversion.

Seasonal Decomposition: Similar to BTC, the scale of seasonality was again very minimal in comparison to that of trends and the absence of seasonality can hence be established.

MACD Gaussian Smoothing: The MACD plot was observed to be highly volatile with a large number of fluctuations over the mean line and the graph didn't stay on either side of the line for a considerable amount of time, hinting at the absence of trends. As MACD is relatively slower it sometimes fails to capture trends while other dynamic indicators like Kalman are able to.

Dickey-Fuller Test: The p-value in this case was also found to be much higher than the critical value and we hence fail to reject the null hypothesis. Thus there is not enough evidence to state if the data is stationary.

III. STRATEGY OVERVIEW

BTC: We created a set of four alphas, including one that was driven by statistics, one that used machine learning, and two that were based on price-action and technical indicators. Even if each of these alphas did well over the course of the cumulative testing period, the results were negatively affected by the wide variations in how well they performed in various market circumstances.

ETH: We created a set of five alphas, including two that were driven by statistics, one that used machine learning, and two that were based on price-action and technical indicators. As the benchmarks for ETH for the given period were quite high any false signal would impact the metrics, and the individual alphas were performing well but there could still be improvements

Solution: So as to tackle this issue, we put in place a dynamic portfolio management system to deal with this problem. This algorithm chooses the best alpha for every time by assessing the state of the market. Important parameters including volatility, Sharpe ratio, mean positive returns, and maximum drawdown are used in the selection process. To calculate an overall alpha score, a particular weight is given to each metric. To make sure the portfolio adjusts to shifting market patterns, these scores are updated on a regular basis. Trades are made in accordance with the recommendations of the alpha that has the greatest score for the specified time frame.

IV. INDIVIDUAL STRATEGY OVERVIEW BTC

A. Burning Phoenix(for BTC)

1) **Overview:** Our strategy draws inspiration from candlestick reversal patterns, notably **Three White Soldiers**, and **Three Black Crows**, here we identified a **four-candlestick pattern** in BTC signals in a **4h** time frame, which also correlates with Gann Angle, and also based on a self-defined risk-minimizing strategy, which also incorporates Aroon, ADX, RSI, ATR, and CHOP indicators, for better entry conditions along with the defined pattern, and also minimizing the risk of entering trades in false signals.

2) **Core Concept:** The candlestick pattern that we are using here is a **modified form of Three White Soldiers and Three Black Crows**, the pattern or the set of criteria that we defined here is based on the pattern that we noticed in BTC, with the help of chart analysis, which is similar to Three White Soldiers and Three black crows, along with the confirmation of other Technical Indicators, for better entry positions.

- **Three White Soldiers:** The first candlestick is a bullish candlestick which is formed after a downtrend, and this Green Bullish candle is followed by two more green bullish candles, whose closing price should be above the previous candle's closing price. The closing price should be higher than the opening price and this indicates that the bulls are back in action. This pattern signals a potential Bullish reversal from a downtrend to an uptrend.
- **Three Black Crows:** The first candlestick is a bearish candlestick which is formed after an uptrend, and the Red Bearish candle is followed by two more Red Bearish candles, whose closing price should be below the previous candle's closing price. The opening price should be higher than the closing price and this indicates that the selling pressure is higher than buying. This pattern signals a potential Bearish reversal from an Uptrend to a Downtrend.



Fig. 1: Three White Soldiers

- The **hypothesis** that we take along the signal generation is that if a signal appears and it reverts to its original price, then that's a false signal, as the signal defined and hence should be squared off before a potential signal reversal, and to experience no future losses, and to implement this we used SR in our strategy, and it also works well in the trendy market as well, setting up a base and also works well if there is a trend shift (based on price action).
 - **Aroon Indicator:** Aroon indicator is used to identify trends and determine the strength of those trends, it consists of Aroon-Up and Aroon-Down, and both of them oscillate between **0 and 100**, we used this as a trend confirmer along with other indicators, to enter the trade at a better position. In Aroon indicator, for **long trades**, the **Aroon-Up** is above **Aroon-Down**, and for **short trades**, the **Aroon Down** is above **Aroon-Up**. This helps us to enter much safer trades, and avoid false signals, created cause of the high volatility.
 - **Average Directional Index (ADX):** The ADX is a technical indicator that measures the strength of a trend, regardless of direction, ADX values oscillate between 0 to 100, and it consists of +DI and -DI, which are based on +DM and -DM (Directional Movement), and can be used to detect potential reversals, but we are using ADX to measure the choppiness, as we don't want to take any trades in the choppy markets, cause of the false signals generated and the sideways movement of the market, which isn't ideal conditions for algo trading, as we try our best to capture the trends and book our profits.
 - **Choppiness Index (CHOP):** CHOP is used to identify whether the market is trending strongly or sideways (choppy), it identifies whether a market is trending or consolidating. It doesn't indicate the direction of the trend but provides important insights into market conditions. Its value varies between 0 to 100, where values closer to 0 indicate a strong trending market, and values closer to 100, indicate a choppy or range-bound market, we used ATR, ADX, and RSI to calculate the CHOP value and based on the threshold, (< 38) for a stable trend, and (> 60) for the market exhibiting high choppiness. We aren't squaring off our position in a choppy market, instead, we aren't taking any signals in this market, as squaring off, your existing position in a choppy market may be usefull in intraday trading, but we didn't do that here as won't be able to overcome the huge commissions charged for each trade. We used **RSI, ADX, AND AROON** indicators, to calculate **CHOP**.
 - **Stagnant Market:** We calculated whether the market is stagnant or not, and if the signals were being generated here, then that signal won't be considered to take any new positions, and will simply be ignored, as for trend to exist then the volatility should exist and if that case isn't fulfilled then no new trades will take place. We calculated if the market was stagnant or not using rolling standard deviation and then normalized it, and compared it with a threshold times of close priced.
- Three crows' pattern is the opposite of the white soldiers' pattern. The Three Black Crows pattern suggests that the market sentiment has shifted from buying to selling, indicating the start of a downtrend.

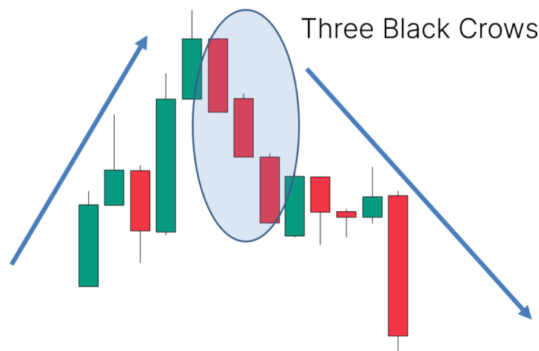


Fig. 2: Three Black Crows

- **Pattern Used:** We tried using technical indicators in our initial strategies, but as technical indicators lag, and the BTC price between 2020 and 2023 end, is very trendy, we weren't able to capture most of the trend due to the lagging nature of technical indicators, hence we look for different approaches, and we identified this pattern, which occurred frequently and was observable in 4H time frame.



Fig. 3: Defined Pattern in BTC for given time frame

This pattern draws its inspiration and resemblance from the three white soldiers and three black crows, but is **completely different from these candlestick patterns**, as it requires some set of criteria/constraints that it has to fulfill, and it is **4 candlestick patterns instead of 3**, and it doesn't require all the candles to be Bullish, to signal a potential uptrend, or all the candles to be Bearish, to signal a potential downtrend."

3) Challenges:

- Not being able to capture the Peak, the strategy wasn't able to capture the trend to the fullest, cause of no new signal generation in a very volatile market, cause of the candle stick pattern formed.
- Facing problems in getting any reasonable returns and high drawdowns due to the lagging nature of indicators; the BTC is highly trendy from 2020 to the end of 2023.
- Trends, high volatility, and the lagging nature of indicators hamper us from entering trades at a better position

in such market conditions.

4) Solution :

- **Signal Generation:** We have defined some set of rules for this pattern, and if the **4 consecutive candlesticks** follow this pattern and fulfill the set criteria defined then it will give us a signal that a **potential uptrend or downtrend** is about to occur, and using this we can enter a trend as soon as it occurs or even before it even occurs, and hence allowing us to enter a trend at a much better position.
- **Using different Indicators:** we paired our candle stick pattern signal generation along with Technical Indicators for a higher probability of the pattern being correct, and less false signals.
- **The conditions defined for long and short, are opposite**, the same as Three white soldiers and the Three Crows.
- The signals generated by the **long and short criteria are completely independent of each other**, the only reason they can work on their own without any other indicators or other interference, is a cause of a large number of signal generations, which is due to the candlestick pattern fulfilling the set of criteria defined (even within a trend).

5) Risk Management :

- We used TP, and SL based on the close price of the current candlestick, and this allowed us to capture the trend more, as both the signals are independent of each other, hence allowing us to get better results, or we may delay the profit if we depend on the counter signal to square off the trade.
- Backtesting on BTC, alone using these signals generated by the set of defined criteria, led to profitable results, but **a huge drawdown of 45%**, so to counteract this, we used the low of the point where the signals are being **generated as support/resistance**, and if the price reverts to its original low price, then we are generating an opposite signal to square off the position that we initially took.
- Doing this has led to minimizing our drawdowns and making the trade more profitable.
- The new signals generated after including this Risk Management(a trend pattern failure level) criteria, we are **able to exit the trades that are based on false signals(immediately)**, and also help in capturing the trend as well, which is **based on price action**, that the consecutive higher low will be above the current higher low in an uptrend, and if the consecutive lower low is below the current lower low, then it will be a downtrend.
- This risk management strategy **draws its inspiration from Three white soldiers and Three black crows**, as they are formed near a trend reversal, and hence can also be **used as trend failure level**.
- If the price falls below the current lower low (if the signal is generated at the previous higher low), then it's a downtrend, and hence our support will be triggered and square-off of the current position will take place, and if

the consecutive higher low is above the previous higher low then the support won't be triggered (in an uptrend) and we will continue our trade, which is going in the direction of an uptrend

- We are only using **1 support/resistance** in a trade to time for a clear and holistic view of the BTC price.

6) **Important:**

- We haven't used any **-2 or +2 signals** in this case the two signal generations are **completely independent of each other**, the only reason they work on their own is the cause of a large number of signal generations at the lower time frame (here 4h).
- We are trying to find a way to **capture the trend more efficiently**, we tried using ATR to define the **Take Profit**, but it **wasn't able to capture the trends to the fullest**, and hence we have to rely on the signals generated by the other criteria defined by us. We are currently trying to use other indicators for better exit conditions, which can capture the trends more effectively.

7) **Correlation/Key Features:**

- **Trend:** We are using the AROON indicator to confirm the Trend with the candle stick pattern, helping us make sure that our pattern agrees with the trend, making sure that the trend might end up in the direction we entered the trade-in.
- **Momentum:** We are using ADX for calculating CHOP, and more the aADX more the momentum of the trend, helping us know if the market is choppy or trendy. RSI also correlates with momentum, the higher the RSI, the higher the momentum,
- **Volatility: Volatility is the key element of our pattern strategy**, and we are also calculating CHOP, using ATR, and its mean value, helping us know when to enter the trade or not.



Fig. 4: Defined Pattern signaling uptrend

B. **Technical Indicators Integration (for BTC)**

1) **Overview:** This strategy aims to tackle the different states of the market by using various technical indicators which perform well in the respective states. The strategy is found to be most effective and beneficial for the **1-day** time period on the BTC data. EMA crossovers coupled with momentum indicators for capturing trends and accompanied with **PSAR** for generating **exit signals** in **Bearish** market define the main essence of the model.

2) **Core Concept:** The core concept of the strategy revolves around the following indicator:

- **Parabolic SAR:** A trend-following indicator that helps identify potential reversal points. If it appears as a series of dots above the asset price, it indicates a **Bearish** trend; if it appears below, a **Bullish** trend is signaled. It is often used as an alternative to a trailing stop-loss.

Equipped with the knowledge of this, one can now move on to the methodology behind the strategy.

- The main block assesses the condition of the market, identifying whether it is trending up, down, or fluctuating. Using a 6-period EMA of RSI, tracking of these trends is done.
- When an uptrend is detected, the EMA block is triggered. If the $EMA_9 > EMA_{20}$, an **uptrend** is confirmed and a **buy** signal is generated. However, if EMA_9 is lower it suggests a potential **trend reversal**; a strong RSI combined with a decreasing EMA hints that the uptrend is losing strength, generating a sell signal.
- If EMA_{RSI} lies between 40 and 60, it indicates fluctuation in the market, leading to the RSI block. If the $RSI_{cur} > 55$ but lower than the RSI from 2 periods prior, it indicates the potential start of a **downward** trend due to short term loss of momentum. In order to ensure better trend capturing, RSI is shifted by 2 periods. Since this is short term, we close any open long position; otherwise, a new short position is opened. In any other scenario, the position is simply held.
- When EMA_{RSI} is less than 40, it indicates a presence of downtrend and the PSAR block comes into picture. PSAR is known to perform well in **downtrends** where it generates a sell signal quickly thus preventing any further losses.

3) **Risk Management :** The PSAR introduces a **dynamic** factor when dealing with stop losses in the market. Due to its inherent ability to trail asset movements, it adapts quickly and effectively to the changes in the trend in the market. It was therefore an excellent option to deal with **volatility** during the highly unstable and volatile period during Jan 2021 to July 2022.

4) **Key Features:** The correlation between trends, volatility and momentum is found to be direct while volume holds scope for a non-direct correlation.

- **Trends and volatility:** EMA crossovers help to capture uptrends efficiently by signaling potential entry points when a shorter EMA **crosses** over a longer one, indicating Bullish momentum. On the other hand, Parabolic SAR provides **good exit** conditions in case of downtrends. Thus by proficiently identifying the trends, we are able to adapt to **ever-changing** market conditions.
- **Momentum:** With the help of RSI, the momentum in the market is identified based on the overbought and oversold conditions. In sideways market, temporary **shift in momentum** was captured but still due to a lagging PSAR, the profits couldn't be maximized.

C. Corroborative Integration (for ETH)

1) **Overview:** This multi-indicator rule-based trading strategy is intended to reduce risks during weak or sideways movements that is when the market is either choppy or stagnant while taking advantage of trending markets. It generates precise entry, exit, and reversal signals by combining various technical indicators in an efficient and profitable manner. The strategy is best suited for the time period of 1 day on the ETH dataset.

2) **Core Concept:** The core concept of the strategy revolves around the following indicators:

- **Schaff Trend Cycle (STC):** The STC offers a broader perspective of the market as it combines the principles of stochastic oscillators and trend following indicators. It identifies trends in the market by measuring the strength of the trend and the speed of price changes. It is faster in comparison to **MACD** and helps identify cycles present in the market. A value greater than a particular threshold indicates **Bullish** momentum while lesser values hint towards **Bearish** momentum
- **RSI:** A momentum indicator which identifies **oversold** and **overbought** conditions. An RSI greater than a particular threshold indicates that the asset is overbought and might pull back while lesser than another particular threshold indicates that the asset is oversold and will rebound. It can also be used for identifying exit points based on the fading bullish or bearish momentum.
- **EMA:** A trend indicator which helps in identifying **trend direction** by giving more weightage to recent asset prices and performs well in comparison with SMA which assigns the same weightage to every point. It hence acts as a **baseline** to determine trend direction in the strategy.
- **Awesome Oscillator (AO):** A momentum based technical indicator which helps understand the market dynamics by comparing the current market momentum to that of previous ones. A **positive** and **increasing** AO hints at **Bullish** momentum while a negative and decreasing one indicates **Bearish** momentum.

Equipped with the knowledge of these indicators, one can now move on to the methodology behind the strategy. Following is the **methodology** along with the entry and exit conditions for both **long** as well as **short** trades.

- While initiating a long trade, certain conditions need to be ensured with the primary one being that the market is not demonstrating a **choppy**, sideways behavior and is in a **bullish** regime or trend.
- The **entry** prerequisite enlists the current close price to move over the EMA_{35} , which acts as a baseline for an uptrend. Additionally, the **STC** value must exceed 50, indicating a transition to bullish market environment. Complementing these signals, the **Awesome Oscillator** must be positive and increasing to confirm a positive momentum. This is done since the market is highly volatile and false signals can be quite detrimental. For **exiting** a long

trade, as soon as the **RSI** drops below 40, which hints at a possibly weakening momentum or the **STC** drops below 20, which indicates end of bullish regime, we square off the trade.

- Similarly for initiating a short trade, it should again be ensured that the market is not demonstrating a choppy, sideways behavior and is in fact in a bearish regime or trend.
- For **entering** a short trade, it is now required that the current close price moves below the EMA, hence signaling a potential downtrend. The **STC** must be less than 50, further solidifying the hypothesis for a downtrend. In the end, the $!pip\ install\ ta-lib$ must be negative and decreasing to confirm a negative descent of the market. Now, for **exiting** a short trade, the **RSI** must exceed 50 or the **STC** should move above 80, indicating overbought conditions.

3) **Risk Management :** Due to the highly **volatile** and risky nature of ETH, **ATR**-based stop-loss and take profit are being implemented. **ATR** based stop-loss and take-profit provide a more objective approach to managing trades. By taking into account market conditions, these levels ensure that we don't miss out on potential profits and escape from the high losses.

4) **Key Features:** The strategy relies on the three major indicators for capturing trends and momentum in the market and the chop indicator and **ATR** based stop-losses for handling volatility.

- **Trends and volatility:** Trends are effectively identified using the combination of **EMA**, **STC** and **AO**. Due to the robust combination and complementing nature of the indicators, the frequency of false signals is minute. Also coupled with the chop indicator, we avoid sideways market and with well-defined take-profit and stop-loss levels, volatility is efficiently tackled.
- **Momentum:** With the help of **RSI**, the momentum in the market is identified based on the overbought and oversold conditions.

D. INDICATOR MAXING(for ETH)

1) **Core concept :** This strategy is based on the same pattern as that we used in Burning Phoenix(IV-G), and paired it with a bunch of indicators, which allow us to know and use all the fundamental aspects of the market, like trend, volume, volatility, and momentum, we are using the same candle stick pattern we used earlier, in our Burning Phoenix strategy, and built up on that also incorporating Take Profit and Stop loss based on **ATR**, to capture the trends more efficiently, we are using **Heiken Ashi**, **MACD**, **Aroon**, **ADX**, **ATR** and also didn't took trades whenever the market gets stagnant which we calculated using Rolling Standard deviation, with a window of 5 days.

Heiken Ashi: Heiken Ashi is, is a Candlestick Chart that is used to filter out noises, and make the trends clearer as we are dealing with highly volatile assets, such as **BTC** and **ETH**, we used **Green** and **Red Heiken Ashi**, as a trend confirmer in

one of our strategies, and used it for better entry positions. Heiken Ashi uses a modified calculation to create “smoothed” candles, which help us identify the trend more clearly. Due to its smoothening, Heiken Ashi lags considering the real-time price, making it unsuitable for entry, by itself.

Aroon Indicator: Aroon indicator is used to identify trends and determine the strength of those trends, it consists of Aroon-Up and Aroon-Down, and both of them oscillate between 0 and 100, we used this as a trend confirmer along with other indicators, to enter the trade at a better position. In Aroon, for long trades, the Aroon-Up is above Aroon-Down, and for short trades, the Aroon Down is above Aroon-Up,

Moving Average Convergence Divergence (MACD): MACD is used to identify changes in the strength, direction, and momentum, it consists of a MACD Line and a signal line, in our strategy we used the difference between the MACD Line and Signal Line (MACD Histogram) if the value of MACD Histogram, then it means there is a possible uptrend, and high changes that the price may enter a bullish regime, and if the MACD histogram decrease or goes down then there are high chances that the price may enter a bullish regime. In our strategy, we used the defined set of conditions for confirming the trend and hence entering much better positions along with other technical indicators, and also helping us to not enter any trades based on false signals.

2) **Challenges** : We recognized the same pattern being followed here, in the same 4h time frame, and used the same strategy as we defined in Strategy 1(IV-G), but we were facing large drawdowns and the market was very volatile throughout the whole period specified for Ethereum. The market moves so rapidly that even after using Take Profit and Stop Loss based on close price isn't able to capture most of the profits, and even if we did enter the trade at a good position we weren't able to square off the trade at a good position, cause of the high volatility of the ETH Market, and cause of high Benchmark.

Incorporating this with a lot of

For risk management, we used Take Profit and Stop Loss, which is based on the Multiple of ATR where the signal is being generated, cause the market is too volatile, and defining a changing Take profit and Stop loss will also enable us to capture most of the trend. This will help us to make the most out of the high volatility and trends of Ethereum. we also used Heiken Ashi a confirm the trend and reduce the risk of entering the trade at a false signal coupling it with MACD, RSI, ADX, CHOP, and AROOUN, which helps in confirming the trend and also helps incorporate all the fundamentals concepts of the market, and look at the overall market conditions, making our trades, more better entry postions.

4) **Key Features/Indicators:** We used the same pattern as we specified in Strategy 1(IV-G), and used it on the time frame of 4h, same as what we used in Strategy 1(IV-G), and we are using different indicators, Arooun, ADX, RSI,ATR, CHOP, Heiken Ashi,MACD. Aroon indicator correлтаes with volatility, and momentum.

E. Temporal Fusion Transformer (for ETH)

1) **Overview:** We tried using the Temporal Fusion Transformer (TFT) model to predict Bitcoin price trends. Our goal is to generate trading signals based on predicted price changes: if the predicted price increases by more than a defined threshold, a **long** position is taken; if it decreases by more than the threshold, a **short** position is taken. The Smooth Moving Average (SMA), Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), and volatility are used as time-varying unknown reals, while month, time index, and the close prices of the previous 1, 2, and 3 days are used as time-varying known reals to provide seasonal context and context of the last 3 timesteps. This approach will be tailored to capture short-term price movements effectively. We have utilized the Heikin-Ashi Candlestick's OHLC data to normalize the original OHLC, effectively smoothing price action and reducing market noise. This transformation provides a clearer view of trends and price movements by averaging out extreme fluctuations. Throughout this section, all references to Open, High, Low, and Close refer to the Heikin-Ashi Candlestick's corresponding Open, High, Low, and Close values, which are derived from the original OHLC data. However this is not used for the final master alpha as it was not compatible with other strategies.

2) **Core Concept:** The core concept of the strategy revolves around the following variables:

- **Predicted Price Change:** The primary signal generated by the TFT model is used to determine trading actions. Based on the threshold values of +0.825% and -0.825%, the model provides us a overview of model's confidence in going long or short on bitcoin market.
- **Close (Unknown Real Variable):** The closing price of Ethereum serves as the primary metric for predicting price trends.
- **SMA_50 and SMA_200 (Unknown Real Variables):** Simple Moving Averages over 50 and 200 periods, respectively, providing insight into short-term and long-term price trends.
- **RSI (Unknown Real Variable):** The Relative Strength Index, which quantifies price momentum and identifies overbought or oversold conditions.
- **MACD and MACD_Signal (Unknown Real Variables):** The Moving Average Convergence Divergence and its signal line, widely used for identifying trend changes and momentum.
- **Rolling_Mean_20 and Rolling_Std_20 (Unknown Real Variables):** The rolling mean and standard deviation over 20 periods, capturing short-term price dynamics and volatility.
- **Volatility_20 (Unknown Real Variable):** A measure of price variability over the past 20 periods, offering insights into market uncertainty.
- **Pct_Change (Unknown Real Variable):** The percentage change in price, reflecting short-term price movements crucial for trend prediction.

- **Time Index (Known Real Variable):** Provides the temporal ordering of data, enabling the model to learn time-dependent patterns and sequences.
 - **Close_Lag_1, Close_Lag_2 and Close_Lag_3 (Known Real Variables):** Represent the closing price of Ethereum lagged by 1, 2 and 3 periods, respectively. These variables introduce historical price context, allowing the model to capture momentum and autocorrelation effects.
 - By combining these features, the model should be able to make more informed predictions, adjusting for periodic fluctuations and significant short-term changes in the market.
- 3) **Risk Management:** Risk management in this strategy is enhanced by incorporating volatility thresholds and precise trade rules:
- **Volatility Filtering:** Trades are initiated only when the **rolling volatility** (calculated over a window of 10 periods) exceeds a defined threshold of **30**. This ensures that the model operates in conditions with significant price movements, reducing the likelihood of false signals during low-volatility phases.
 - **Stop-Loss Mechanism:** A **strict stop-loss** is implemented to limit potential losses. Each trade has a maximum allowable loss before it is automatically squared off. The stop-loss is actively monitored during each trade cycle, ensuring robust protection against adverse market movements. remove stop loss and add volatility
 - **Threshold Optimization:** A **0.825%** threshold for percentage change ensures that trades are based on meaningful price movements while minimizing excessive activity.
 - **Trade Rules:** Positions are classified as long, short, neutral, or reversals based on percentage change, with explicit conditions to avoid unnecessary trades during low-confidence scenarios.
- 4) **Key Features:** The following key features and indicators are critical in enhancing the predictive power and effectiveness of the strategy:
- **Predicted Price (TFT Output):** The core of the strategy, the predicted price generated by the Temporal Fusion Transformer (TFT), dictates the trading signals. It determines whether to go long or short based on the model's forecast of Ethereum's future price movements.
 - **Technical Indicators:**
 - **SMA_50 and SMA_200:** Simple Moving Averages over 50 and 200 periods, used to assess the market's short-term and long-term trends.
 - **RSI:** The Relative Strength Index measures price momentum and identifies overbought or oversold conditions, enhancing entry and exit timing.
 - **MACD and MACD_Signal:** Moving Average Convergence Divergence and its signal line, providing insights into trend strength and potential reversals.
 - **Volatility Metrics:** Includes **Rolling Mean** and **Rolling Std** over 20 periods to capture short-term market fluctuations and assess risk.
 - **Lagged Prices (Close_Lag_1, Close_Lag_2, Close_Lag_3):** These variables represent the closing price lagged by 1, 2, and 3 periods. They incorporate historical price information to account for momentum and autocorrelation, helping the model understand past price behavior and predict future trends.
 - **Threshold Optimization:** The **0.825%** threshold for entry and exit ensures the model only acts on significant price movements, minimizing noise and optimizing trade decisions.
- 5) **Challenges and Future Scope:** Challenges faced include the following:
- **Testing:** To elevate the model's performance across the time frames, rigorous testing is essential. Methods like **rolling window cross-validation** will be used to assess and improve the model's reliability across various market conditions. This approach ensures that the model is stress-tested, capturing diverse market behaviors and preventing overfitting to a particular period or trend. We have tried some methods but it leads to overfitting which reduces the final results.
 - **Reinforcement Learning:** Optimize the model's performance through the application of reinforcement learning techniques. Applying RL will allow the model to continuously learn and adapt its trading decisions based on the experience, optimizing performance by learning from both profitable and adverse market scenarios.

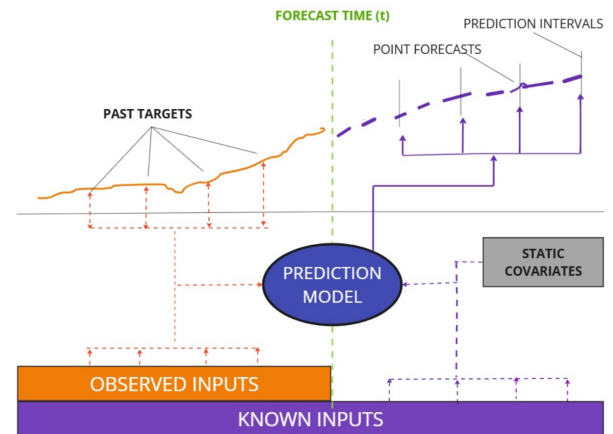


Fig. 5: Regression of BTC onto ETH

F. Kalman Filter(BTC))

1) **Overview:** The analysis of BTC/USDT price shows that it is highly volatile and contains a lot of noise, so to filter out this noise and capture the trend without hitting stop-losses Kalman Filter is used to smooth out the prices and combined with other technical indicators like Schaff Trend Cycle (STC) along with volume confirmation to avoid false breakouts. The proposed strategy leverages the Kalman filter, liquidity, and the Schaff Trend Cycle (STC) indicator to identify robust buy and sell signals in bullish or bearish regimes.

2) **Core Concept:** The core concept of the strategy revolves around the following concepts:

- **Smoothed Prices (Kalman Filter):** The Kalman Filter is used to smooth out the prices and remove the noise as it offers dynamic adaptability and filter out the noise based on the uncertainty of the input data. Unlike the EMA, which uses fixed weights, the Kalman Filter dynamically updates its state and error covariance to provide an optimal estimate of the "true" price. Thus using Kalman Filter is beneficial in volatile markets where price data can be noisy and erratic. So when the current price is greater than the smoothed price at that moment suggests that the asset is in uptrend or a bullish trend is going to start and vice versa.
- **Schaff Trend Cycle (STC):** As explained above, STC is used to identify the current sentiment of the market. This strategy uses a threshold value of 50 to identify bullish and bearish regimes i.e. if $STC \geq 50$ this implies Bullish regime and $STC < 50$ implies Bearish regime. Combining this with the smoothed prices logic generates more accurate buy and sell signals but this is not sufficient enough to avoid false breakouts.
- **Liquidity (Volume):** A higher volume indicates higher buying/selling pressure, greater market participation and a potential for the prices to increase in future. So this strategy along with the above two conditions utilizes this fact and uses a threshold value of 14 for rolling window i.e. if the current candle's volume is greater than the rolling mean of volume over the past 14 days(2 weeks) signifies that the breakout or trend have a higher chances that the trend is going to start or continue further.
- **Signal Generation Conditions:**
 - a) **Buy Signal:** A buy signal is generated when:
 - The close price is greater than the Kalman-filtered price.
 - Current Volume is greater than last 14 days average volume.
 - The STC indicator exceeds 50, indicating a bullish market regime.
 - b) **Sell Signal:** A sell signal is generated when:
 - The close price is lower the Kalman-filtered price.
 - Current Volume is greater than last 14 days average volume.
 - The STC indicator is below 50, indicating a bearish regime.

3) **Risk Management :** Due to the highly volatile and risky nature of BTC, a fixed stop loss of 7 percent is set for every trade. And a target price of 100 percent is set for every trade.

G. Kalman Filter(ETH))

1) **Overview:** The analysis of ETH/USDT price shows that it is highly volatile and contains a lot of noise, so to filter out this noise and capture the trend without hitting stop-losses Kalman Filter is used to smooth out the prices and combined with other technical indicators like Schaff Trend Cycle (STC) along with volume confirmation to avoid false breakouts. The proposed strategy leverages the Kalman filter, liquidity, and the Schaff Trend Cycle (STC) indicator to identify robust buy and sell signals in bullish or bearish regimes.

2) **Core Concept:** The core concept of the strategy revolves around the following concepts:

- **Smoothed Prices (Kalman Filter):** The Kalman Filter is used to smooth out the prices and remove the noise as it offers dynamic adaptability and filter out the noise based on the uncertainty of the input data. Unlike the EMA, which uses fixed weights, the Kalman Filter dynamically updates its state and error covariance to provide an optimal estimate of the "true" price. Thus using Kalman Filter is beneficial in volatile markets where price data can be noisy and erratic. So when the current price is greater than the smoothed price at that moment suggests that the asset is in uptrend or a bullish trend is going to start and vice versa.
- **Schaff Trend Cycle (STC):** As explained above, STC is used to identify the current sentiment of the market. This strategy uses a threshold value of 50 to identify bullish and bearish regimes i.e. if $STC \geq 50$ this implies Bullish regime and $STC < 50$ implies Bearish regime. Combining this with the smoothed prices logic generates more accurate buy and sell signals but this is not sufficient enough to avoid false breakouts.
- **Liquidity (Volume):** A higher volume indicates higher buying/selling pressure, greater market participation and a potential for the prices to increase in future. So this strategy along with the above two conditions utilizes this fact and uses a threshold value of 7 for rolling window i.e. if the current candle's volume is greater than the rolling mean of volume over the past 7 days(1 week) signifies that the breakout or trend have a higher chances that the trend is going to start or continue further.

3) **Risk Management :** Due to the highly volatile and risky nature of BTC, a fixed stop loss of 7 percent is set for every trade. And a target price of 100 percent is set for every trade.

V. PERFORMANCE METRICS

A. Master Alpha (for ETH)

a) Performance:

- The initial trading balance was set at **\$1,000**, and the strategy demonstrated significant growth, resulting in a final balance of **\$9755690.59**.
- The total profit percentage over the backtest period was an impressive **975469.%**.
- The portfolio balance peaked at a maximum of **\$11076069.7**, while the minimum recorded balance remained at the initial **\$1,000**.

b) Win-Loss:

- A total of **159 trades** were executed, capturing opportunities across various market conditions.
- Profitability was sustained despite the observed volatility, with the largest profit (PnL) reaching **\$1497005** and the largest loss recorded as **-\$1190823.6**.

c) Risk Metrics:

- The maximum drawdown, of static statistics, was recorded at **8.49%**.
- On average, drawdowns remained manageable at **0.96%**, minimizing prolonged downturns.
- The maximum Time to Recovery (TTR) was **105 days**, signifying the duration required to recover from the largest drawdown. The average TTR was **22.5 days**, demonstrating resilience in adverse market conditions.

d) Benchmark Beaten:

- Outperformed the benchmark in **14 out of 16 quarters**, showcasing consistent performance over shorter intervals.
- On an annual scale, the strategy beat the benchmark in **all 4 years**, demonstrating long-term reliability and success.

e) Fees:

- Total transaction fees incurred during the trading period amounted to **\$341508.79**. These costs were well justified given the significant overall returns achieved.

B. Master Alpha (for BTC)

a) Performance:

- The initial trading balance was set at **\$1,000**, and the strategy demonstrated significant growth, resulting in a final balance of **\$52409.5**.
- The total profit percentage over the backtest period was an impressive **5140.9%**.
- The portfolio balance peaked at a maximum of **\$25470.18**, while the minimum recorded balance remained at **\$958.9**.

b) Win-Loss:

- A total of **116 trades** were executed, capturing opportunities across various market conditions.
- Profitability was sustained despite the observed volatility, with the largest profit (PnL) reaching **\$17202.3** and the largest loss recorded as **-\$6548.9**.

c) Risk Metrics:

- The maximum drawdown, of static statistics was recorded at **10%**.
- On average, drawdowns remained manageable at **1.66%**, minimizing prolonged downturns.
- The maximum Time to Recovery (TTR) was **266 days**, signifying the duration required to recover from the largest drawdown. The average TTR was **41.2 days**, demonstrating resilience in adverse market conditions.

d) Benchmark Beaten:

- Outperformed the benchmark in **9 out of 16 quarters**, showcasing consistent performance over shorter intervals.
- On an annual scale, the strategy beat the benchmark in **3 out of 4 years**, demonstrating long-term reliability and success.

e) Fees:

- Total transaction fees incurred during the trading period amounted to **\$2558.2**. These costs were well justified given the significant overall returns achieved.

Strategy	Profit / Loss	Sharpe Ratio	Annualized Return (%)	Max Drawdown	Time to Recovery	MAE
Master Alpha (for ETH)	975469.%	8.93	893.84%	8.49%	105 days	54.13%
Master Alpha (for BTC)	5140.9%	6.59	169%	10%	266 days	28.5%

TABLE I: Final Result of Strategies

VI. PLOTS



Fig. 6: Master Alpha (ETH)

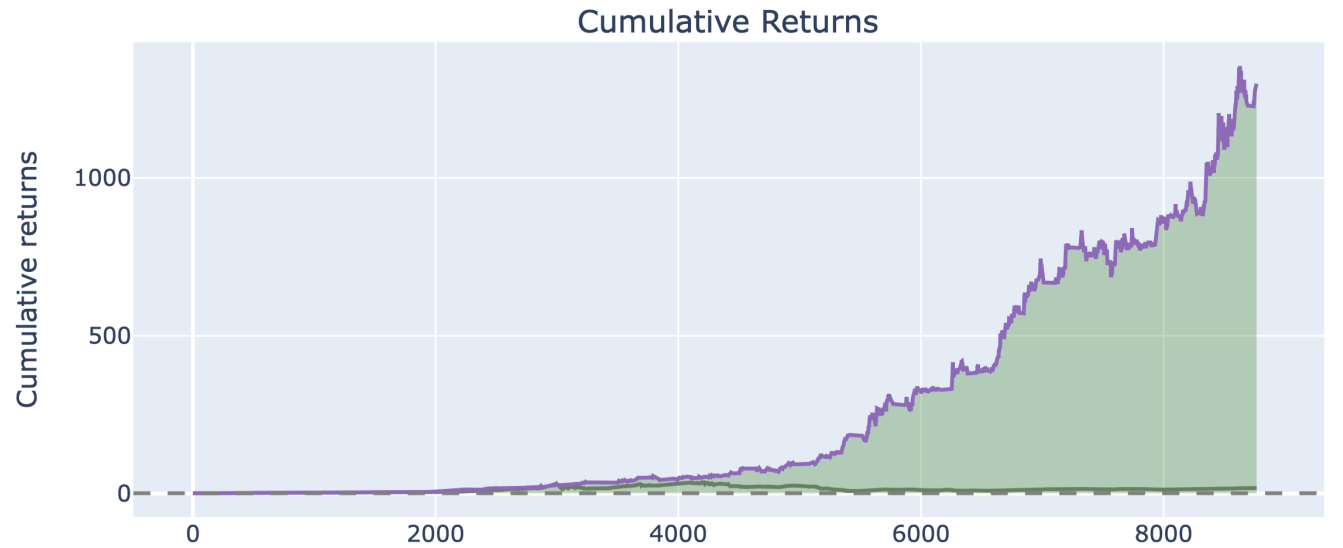


Fig. 7: Master Alpha (ETH)



Fig. 8: Master Alpha (BTC)

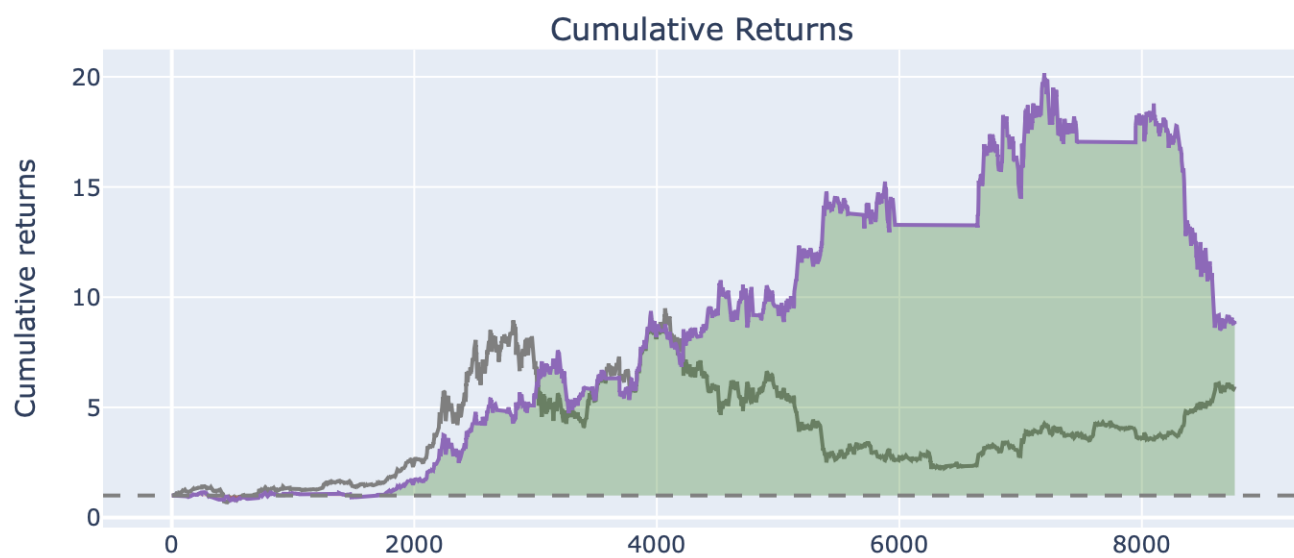


Fig. 9: Master Alpha (BTC)

VII. PORTFOLIO MANAGER

Portfolio manager is the core component of the strategy, which dynamically chooses the best trading plan in accordance to current market movements. It guarantees that the portfolio adjusts to shifting market conditions, optimizing returns and lowering risk, by regularly evaluating the performance of several alphas.

1) **How It Works:** The system operates on a pool of strategies, each designed to excel under different market scenarios. These strategies produce trading signals, trade types, and performance metrics. The portfolio manager uses a sliding evaluation window to analyze the performance of strategies over recent market periods. Key financial metrics are computed for each strategy:

- **Volatility:** Measures the standard deviation of returns to gauge risk.
- **Mean Positive Returns:** Evaluates the average of profitable returns.
- **Maximum Drawdown:** Assesses the largest peak-to-trough loss to identify risk exposure.
- **Sharpe Ratio:** Calculates risk-adjusted returns.

Every metric is given a weight that corresponds to its significance. Each strategy's weighted scores are combined to create a composite alpha score, which is updated periodically. The portfolio manager chooses the strategy with the highest alpha score for the upcoming period. The signals and trade type of the chosen strategy control trades. Depending on the strategy selected, the take-profit (TP) and stop-loss (SL) levels are dynamically modified. The portfolio manager addresses frequent issues in static or single-strategy systems by introducing a methodical, data-driven approach to strategy selection:

- **Adaptability:** In contrast to conventional methods, the manager dynamically modifies its strategy to maintain its efficacy in a range of market circumstances.
- **Risk Mitigation:** During volatile or unfavorable market times, riskier tactics are deprioritized due to multi-metric evaluation.
- **Improved Performance:** The portfolio manager maximizes profitability without overexposure to any one strategy by instantly choosing the top-performing one.

2) **Choosing optimal change period:** For each standard interval, the portfolio manager's performance was assessed. Significant volatility and rapid trend swings are characteristics of cryptocurrencies markets. Longer evaluation intervals (such as 60 days) during testing resulted in less-than-ideal performance since the portfolio was unable to adapt to quick market reversals. On the other hand, overfitting to short-term noise at shorter intervals (daily, for example) resulted in excessive strategy switching, which raised transaction costs and decreased overall returns. The best interval was found to be a 7-

day. The 7-day window consistently beat both shorter and longer intervals in terms of cumulative returns and risk-adjusted parameters, according to backtesting over historical data.

VIII. UNIQUE APPROACH AND INNOVATION

A. Plot for Trend Analysis

- **Pattern Identification:** We have identified a pattern which is **most frequent in 4h high volatile market**, and used them to get in trades even before, or as soon as they begin, but they may sometimes give false signals, and this mostly leads to high drawdown, when used on their own. To reduce the drawdown and to make the most out of the trend, we paired this candlestick pattern, which is a set of constraints, with Take Profit, and Stop Loss and also tried pairing them with Support and Resistance, but it gave better results with Take Profit and Stop Loss.
- **Portfolio Manager:** This strategy also known as **Master Strategy** dynamically chooses alphas from a pool of alphas to adjust to change in in market trends and fluctuations. This strategy **continuously** evaluates the performance of **individual strategies** over various time frames and selects the one that have performed well in the previous time frame. This strategy adapts by **re-weighting** the alphas to align with trend-shifts, making the overall portfolio more reliable.

B. Difference from Traditional Methods

- We have **not used any kind of traditional patterns, in new pattern recognition strategy**, which are widely used by people, instead we took inspiration from an existing trend reversal candlestick pattern, and through chart analysis, recognized this pattern or set of criteria being repeated in **BTC in the 4H** time frame, and the same approach gave us **really good result in Ethereum** when paired with Take Profit and Stop Loss.