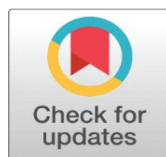# IDENTIFICATION AND CODING OF ELLIOT WAVE PATTERN

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ABSTRACT

Prediction of stock price and modelling of market pattern are quite difficult and complex to understand itself. There are hidden factors of market like effect of news, sentiment of crowd etc. which play an important role of modelling the market pattern. The modelling of market patterns was primarily developed by R.N. Elliott. The Elliott Wave theory was described subjectively in literature and wave patterns cannot be identify easily. In this work, we mainly focus on identification of wave pattern through Fractal indicators and Awesome Oscillator using R programming.

Keywords: Fractal Indicator, Awesome Oscillator, Elliott Wave, Elliott Wave Formation

1. INTRODUCTION

In modern financial analysis, many economists suggest that traditional model is not enough to perform entire analysis. If market is driven by people than the traditional analysis should be combined with psychology and human behaviour. If the psychological behaviour of traders and investors is taken into consideration it indicates that in certain situation, they often react in the same pattern; either panic buying/selling or holding. Such behaviour of traders and investors leads to drastic increase in buying/selling which creates buying/selling pressure in the market. This type of pressure creates patterns in price movements and the market moves with these price patterns.

We can predict the market movement using price patterns. One of the simplest patterns of market is fractal pattern. When there is buying pressure in the market than market moves in upward direction but after certain time market will definitely change the direction due to lack of buyers. Such movement of price creates fractal pattern. If the strength of buyers/seller is not sufficient then it leads to up/down fractal.

1.1. FRACTAL INDICATOR WILLIAMS (1998)

The Fractal Indicator is a pattern indicator, and it is developed by Bill Williams in 1998 in his book 'New Trading Dimensions: How to Profit from Chaos in Stocks, Bonds, and Commodities'. Originally, He developed this pattern indicator for generating buy-stop/sell-stop in Alligator Indicator. In the Fractal Indicator, pattern is made by five consecutive candles and the high/low of middle candle is highest high/lowest low among all five candles. There are three different types of patterns in Fractal Indicator which are represented in the following Figure 1. In this work, we mainly use Type-I pattern.

Figure 1
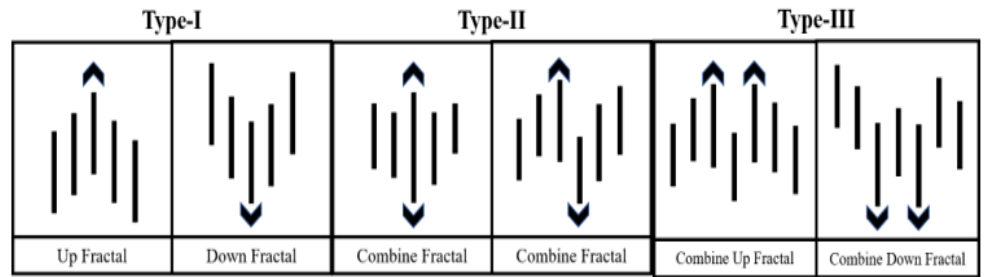
Figure 1

Calculation

Up Fractal	Down Fractal
$High(n) > High(n-2)$	$Low(n) > Low(n-2)$
$High(n) > High(n-1)$	$Low(n) > Low(n-1)$
$High(n) > High(n+1)$	$Low(n) > Low(n+1)$
$High(n) > High(n+2)$	$Low(n) > Low(n+2)$

where,

$n = $ Middle candle among five candles

$n-1 = $ First left candle of Middle Candle

$n+1 = $ First right candle of Middle Candle

$n-2 = $ Second left candle of Middle Candle

$n+2 = $ Second right candle of Middle Candle

1.2. AWESOME OSCILLATOR (AO) WILLIAMS (1998)

According to Bill Williams, Awesome Oscillator is the best momentum indicator, and it is non-limiting oscillator. AO measures the speed of change in price of last five days and compares it with the speed of change in price of last thirty-four days. The value of AO is oscillated around zero.

Calculation

$$Simple\ Movine\ Average\ (SMA) = SMA(Price, Period)$$

$$Mid\ Price = \frac{High\ Price - Low\ Price}{2}$$

$$5\ Period\ SMA = SMA(Mid\ Price, 5)$$

$$34\ Period\ SMA = SMA(Mid\ Price, 34)$$

$$AO = 5\ Period\ SMA - 34\ Period\ SMA$$

1.3. ELLIOTT WAVE

The Elliott Wave is mainly divided into two waves: 1) an impulse wave, which net travels in the same direction as the larger trend, always shows five waves in its pattern and 2) a corrective wave, on the other hand, net travels in the opposite direction of the main trend. Elliott (1946)

As shown in Figure 1 the wave formation consists of 5 waves in the direction of primary/impulsive wave marked as 1, 2, 3, 4 and 5. It is followed by three waves in reverse direction of main trend which is called corrective waves marked as A, B and C. As shown in Figure 2, inner wave marked as 1, 3 and 5 are also impulsive waves of smaller degree. So, the wave 1, wave 3 and wave 5 are parts of impulsive wave in upward direction. Elliott (1946)

Though Elliott waves follow many rules, but three basic rules are followed by each wave to interpret the Elliott wave. These guidelines are unbreakable. These rules are as follows:

- Rule 1: Wave 2 is not retracted more than 100% of wave 1.
- Rule 2: Wave 3 can never be the shortest wave among the 5 waves of impulse.
- Rule 3: Wave 4 cannot touch Wave 1. Elliott (1946)

Figure 2

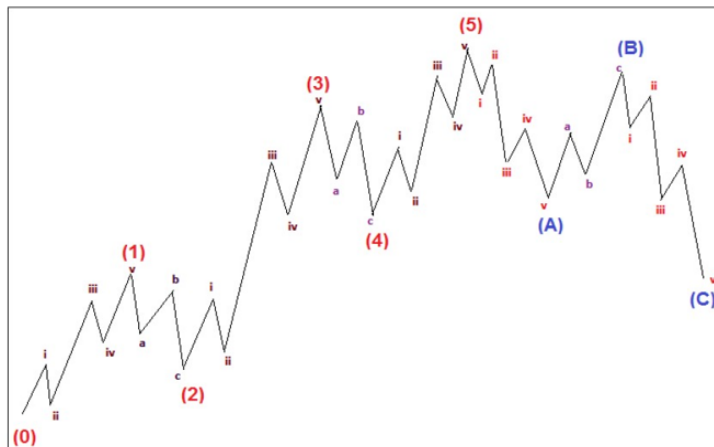
Figure 2 Elliott Wave Elliott (1946)

Elliott Wave formation using Fractal Indicator and Awesome Oscillator

The Elliott Wave pattern can be classified into two waves namely Impulse wave and Corrective wave. The main Impulse wave includes five wave points, and the main Corrective wave includes three wave points. In the main Impulse wave, wave points 1, 3 and 5 are end point of impulse wave and wave points 2 and 4 are end point of corrective wave. According to the rules of Elliott Wave formation, if we find the five points of impulse wave then the remaining 3 points can be easily predicted. So, in this work, me mainly focus on identifying 5 wave points of main Impulse wave. For that, we use Fractal Indicator and Awesome Oscillator.

In the Elliott Wave, first five wave points can be identified using up and down Fractal. But it is not necessary that every fractal is wave point. In addition to this, every rule of Elliott wave formation must be followed to become a wave point. To identify wave points 1, 3 and 5, two information are needed: 1) up fractal and 2) a change in trend coming from that (particular) point. And to identify wave points 2 and 4, two information are needed: 1) down fractal and 2) a change in trend coming from that (particular) point. This trend change can identify using Awesome Oscillator. So, in this work, we try to find out the Elliott Wave formation using Fractal Indicator and Awesome Oscillator.

2. LITERATURE REVIEW

Elliott (1946) published his definitive work on wave principle. He developed the wave theory based on human behaviour in a specific pattern. Using stock market data as his main research tool, Elliott had isolated thirteen patterns of movement, or "waves," that recur in market price data. Elliott (1946)

Williams (1998) developed the new concepts combining trading psychology and chaos theory on the stock markets. He introduced markets inherent parts into five trading dimensions. He described the leading indicator called Awesome Oscillator (AO) which measures immediate momentum of the market. Williams (1998)

Akar and Ugur (2021) studied the stock price prediction of tesla motors using different technical indicators. he also used machine learning algorithms namely long short-term memory model (LSTM) for price prediction. he observed that investor should use more than one indicator for trend identification. He analysed that LSTM might predict an unexpected jump in the stock price and help in finding the entry and exit signals. Akar and Ugur (2021)

Iovane et al. (2016) introduced the multiparametric methodology (MIAMI Model) for financial trading, investment, and prospects analysis Iovane et al. (2016).

Roy (2020) explained how the movement of the market can be captured by the Bill Williams invented Alligator, Fractal and Awesome Oscillator. He discussed how to make quick profits from the above indicators in swing trading. Also, he emphasized on risk management and proper position trading in a market. Roy (2020)

Vaghela and Gor (2020) worked on Elliott wave theory with a combination of sentiment indicator put-call ratio to reduce the complexity of Elliott wave theory. They tried to identify the wave pattern by put call ratio indicator. Vaghela and Gor (2020)

Vaghela et al. (2021) constructed a combined strategy of Commodity Channel Index (CCI) and Double Exponential Moving Average (DEMA) for the Elliott wave

formation. They examined that the combined strategy provides better buying and selling opportunity Vaghela et al. (2021).

Vaghela et al. (2021) developed Elliott wave creation through Stochastic Oscillator and Average Directional Indicator (ADX). They concluded that ADX is better at wave formation than Stochastic Oscillator. Also, this strategy helps to identify the upcoming trend in the market. Vaghela et al. (2021)

Panchal et al. (2020) introduced a new trading method of Bollinger Bands namely Moving Fibonacci Strategy (MF Strategy) and concluded that MF strategy identify signal when security prices were around the moving average and that is a short fall of Bollinger Bands strategy Panchal et al. (2020).

Panchal and Gor (2022) worked on comparative study of different investing strategies namely DCRSI Strategy, PSAREMA Strategy and MF Strategy with the oldest and basic strategy Moving Average Crossover Panchal and Gor (2022).

3. FRACTAL INDICATOR THROUGH EXCEL AND R PROGRAMMING

- **Excel**

1) Find the High(n-2), High(n-1), High(n), High(n+1), High(n+2), Low(n-2), Low(n-1), Low (n), Low (n+1) and Low (n+2) value from data

2) Outcome: - IF(E2>=C2, E2>=D2, E2>=F2, E2>=G2,"Up Fractal","0") and IF (E2<=C2, E2<=D2, E2<=F2, E2<=G2,"Down Fractal","0")

	A	B	C	D	E	F	G	H
			High	High				
1	Date	High	(n-2)	(n-1)	High(n)	High(n+1)	High(n+2)	Outcome
2	6/1/2021	2202	2,105.00	2,191.70	2,202.00	2,209.50	2,250.00	0
3	6/2/2021	2209.5	2,191.70	2,202.00	2,209.50	2,250.00	2,216.45	0
4	6/3/2021	2250	2,202.00	2,209.50	2,250.00	2,216.45	2,242.00	Up Fractal
5	6/4/2021	2216.45	2,209.50	2,250.00	2,216.45	2,242.00	2,227.15	0
6	6/7/2021	2242	2,250.00	2,216.45	2,242.00	2,227.15	2,221.00	0
7	6/8/2021	2227.15	2,216.45	2,242.00	2,227.15	2,221.00	2,230.00	0
8	6/9/2021	2221	2,242.00	2,227.15	2,221.00	2,230.00	2,228.00	0
9	6/10/2021	2230	2,227.15	2,221.00	2,230.00	2,228.00	2,258.25	0
10	6/11/2021	2228	2,221.00	2,230.00	2,228.00	2,258.25	2,274.90	0
11	6/14/2021	2258.25	2,230.00	2,228.00	2,258.25	2,274.90	2,247.05	0
12	6/15/2021	2274.9	2,228.00	2,258.25	2,274.90	2,247.05	2,235.00	Up Fractal
13	6/16/2021	2247.05	2,258.25	2,274.90	2,247.05	2,235.00	2,235.00	0
14	6/17/2021	2235	2,274.90	2,247.05	2,235.00	2,235.00	2,247.50	0
15	6/18/2021	2235	2,247.05	2,235.00	2,235.00	2,247.50	2,261.00	0
16	6/21/2021	2247.5	2,235.00	2,235.00	2,247.50	2,261.00	2,250.60	0
17	6/22/2021	2261	2,235.00	2,247.50	2,261.00	2,250.60	2,214.60	Up Fractal
18	6/23/2021	2250.6	2,247.50	2,261.00	2,250.60	2,214.60	2,153.50	0
19	6/24/2021	2214.6	2,261.00	2,250.60	2,214.60	2,153.50	2,126.50	0
20	6/25/2021	2153.5	2,250.60	2,214.60	2,153.50	2,126.50	2,109.00	0
21	6/28/2021	2126.5	2,214.60	2,153.50	2,126.50	2,109.00	2,122.65	0
22	6/29/2021	2109	2,153.50	2,126.50	2,109.00	2,122.65	2,123.15	0
23	6/30/2021	2122.65	2,126.50	2,109.00	2,122.65	2,123.15	2,132.90	0

24	7/1/2021	2123.15	2,109.00	2,122.65	2,123.15	2,132.90	2,153.55	0
25	7/2/2021	2132.9	2,122.65	2,123.15	2,132.90	2,153.55	2,148.90	0
26	7/5/2021	2153.55	2,123.15	2,132.90	2,153.55	2,148.90	2,127.75	Up Fractal

	A	B	C	D	E	F	G	H
1	Date	Low	Low (n-2)	Low (n-1)	Low (n)	Low(n+1)	Low(n+2)	Outcome
2	6/1/2021	2146.5	1,990.00	2,085.05	2,146.50	2,157.00	2,196.10	0
3	6/2/2021	2157	2,085.05	2,146.50	2,157.00	2,196.10	2,184.25	0
4	6/3/2021	2196.1	2,146.50	2,157.00	2,196.10	2,184.25	2,185.00	0
5	6/4/2021	2184.25	2,157.00	2,196.10	2,184.25	2,185.00	2,198.15	0
6	6/7/2021	2185	2,196.10	2,184.25	2,185.00	2,198.15	2,157.95	0
7	6/8/2021	2198.15	2,184.25	2,185.00	2,198.15	2,157.95	2,177.55	0
8	6/9/2021	2157.95	2,185.00	2,198.15	2,157.95	2,177.55	2,180.10	DownFractal
9	6/10/2021	2177.55	2,198.15	2,157.95	2,177.55	2,180.10	2,195.05	0
10	6/11/2021	2180.1	2,157.95	2,177.55	2,180.10	2,195.05	2,240.30	0
11	6/14/2021	2195.05	2,177.55	2,180.10	2,195.05	2,240.30	2,205.85	0
12	6/15/2021	2240.3	2,180.10	2,195.05	2,240.30	2,205.85	2,179.90	0
13	6/16/2021	2205.85	2,195.05	2,240.30	2,205.85	2,179.90	2,184.35	0
14	6/17/2021	2179.9	2,240.30	2,205.85	2,179.90	2,184.35	2,200.15	DownFractal
15	6/18/2021	2184.35	2,205.85	2,179.90	2,184.35	2,200.15	2,219.35	0
16	6/21/2021	2200.15	2,179.90	2,184.35	2,200.15	2,219.35	2,201.70	0
17	6/22/2021	2219.35	2,184.35	2,200.15	2,219.35	2,201.70	2,140.00	0
18	6/23/2021	2201.7	2,200.15	2,219.35	2,201.70	2,140.00	2,081.10	0
19	6/24/2021	2140	2,219.35	2,201.70	2,140.00	2,081.10	2,081.00	0
20	6/25/2021	2081.1	2,201.70	2,140.00	2,081.10	2,081.00	2,084.10	0
21	6/28/2021	2081	2,140.00	2,081.10	2,081.00	2,084.10	2,091.05	DownFractal
22	6/29/2021	2084.1	2,081.10	2,081.00	2,084.10	2,091.05	2,095.00	0
23	6/30/2021	2091.05	2,081.00	2,084.10	2,091.05	2,095.00	2,092.95	0
24	7/1/2021	2095	2,084.10	2,091.05	2,095.00	2,092.95	2,131.50	0
25	7/2/2021	2092.95	2,091.05	2,095.00	2,092.95	2,131.50	2,120.20	0
26	7/5/2021	2131.5	2,095.00	2,092.95	2,131.50	2,120.20	2,098.00	0

- **R-Programming: (some important steps)**
1) Import data from yahoo finance.
2) Data manipulation: Omit 'Null' value from the data.
3) Find the High(n-2), High(n-1), High(n), High(n+1), High(n+2), Low(n-2), Low(n-1), Low (n), Low (n+1) and Low (n+2) value from data.
4) Using above value find Up Fractal and Down Fractal.

4. AWESOME OSCILLATOR THROUGH EXCEL AND R PROGRAMMING

- **Excel**
1) Mid-Price: - $High + Low/2$
2) SMA(Mid-Price,5): - Average (previous 5 days Mid-Price)
3) SMA(Mid-Price,34): - Average (previous 34 days Mid-Price)

4) AO: - SMA(Mid-Price,5) - SMA(Mid-Price,34)

5) Trend: - IF(C2>C3, DOWN) & IF (C2<C3, UP)

	A	B	C	D	E	F	G	H
1	Date	High	Low	Mid-Price	SMA(Mid-Price,5)	SMA(Mid-Price,34)	AO	Trend
2	6/1/2021	2202	2146.5	2174.25	2062.03	1966.9566	95.073382	UP
3	6/2/2021	2209.5	2157	2183.25	2104.2	1974.3809	129.81912	UP
4	6/3/2021	2250	2196.1	2223.05	2153.285	1983.0228	170.26221	UP
5	6/4/2021	2216.45	2184.25	2200.35	2183.855	1990.7684	193.08662	UP
6	6/7/2021	2242	2185	2213.5	2198.88	1998.8662	200.01382	UP
7	6/8/2021	2227.15	2198.15	2212.65	2206.56	2007.9676	198.59235	DOWN
8	6/9/2021	2221	2157.95	2189.475	2207.805	2016.3426	191.46235	DOWN
9	6/10/2021	2230	2177.55	2203.775	2203.95	2025.4074	178.54265	DOWN
10	6/11/2021	2228	2180.1	2204.05	2204.69	2034.1404	170.54956	DOWN
11	6/14/2021	2258.25	2195.05	2226.65	2207.32	2042.6669	164.65309	DOWN
12	6/15/2021	2274.9	2240.3	2257.6	2216.31	2051.1926	165.11735	UP
13	6/16/2021	2247.05	2205.85	2226.45	2223.705	2058.0272	165.67779	UP
14	6/17/2021	2235	2179.9	2207.45	2224.44	2063.3669	161.07309	DOWN
15	6/18/2021	2235	2184.35	2209.675	2225.565	2069.1875	156.3775	DOWN
16	6/21/2021	2247.5	2200.15	2223.825	2225	2076.9162	148.08382	DOWN
17	6/22/2021	2261	2219.35	2240.175	2221.515	2085.7625	135.7525	DOWN
18	6/23/2021	2250.6	2201.7	2226.15	2221.455	2094.6706	126.78441	DOWN
19	6/24/2021	2214.6	2140	2177.3	2215.425	2102.2147	113.21029	DOWN
20	6/25/2021	2153.5	2081.1	2117.3	2196.95	2107.4051	89.544853	DOWN
21	6/28/2021	2126.5	2081	2103.75	2172.935	2112.4015	60.533529	DOWN
22	6/29/2021	2109	2084.1	2096.55	2144.21	2117.4684	26.741618	DOWN
23	6/30/2021	2122.65	2091.05	2106.85	2120.35	2122.9654	-2.615441	DOWN
24	7/1/2021	2123.15	2095	2109.075	2106.705	2128.4088	-21.70382	DOWN
25	7/2/2021	2132.9	2092.95	2112.925	2105.83	2133.2912	-27.46118	DOWN
26	7/5/2021	2153.55	2131.5	2142.525	2113.585	2137.8493	-24.26426	UP

- **R-Programming: (some important steps)**

1) Import data from yahoo finance.

2) Data manipulation: Omit 'Null' value from the data.

3) Find Mid-Price.

4) Calculate SMA(Mid-Price,5), SMA(Mid-Price,34) and then after calculate AO.

5) Plot AO.

5. RESEARCH METHODOLOGY
5.1. OBJECTIVE

To identify exact Elliott wave pattern using its subjective rules through Fractal Indicator and Awesome Oscillator.

To derive R-code and Excel-code for Fractal Indicator and Awesome Oscillator.

To identify the Elliott wave pattern in security prices using the programming language R

5.2. DATA COLLECTION

- In this work, we have taken daily data from NSE website.
- We collected stock price data from January 2005 to March 2022 from NSE website.
- To demonstrate the study, we use four companies: Reliance Industry pvt. Ltd. (RELIANCE.NS), Aarti Industries Limited (AARTIIND.NS), Dr. Reddy's Laboratories Limited (DRREDDY.NS), Graphite India Limited (GRAPHITE.NS). The choice of the companies is random.

5.3. COMPUTATION

All the computations are performed in R-Programming. The step wise procedure is given below.

- Take a data of security from NSE/BSE.
- Clean the data of security that is removing non-trading day using excel.
- Import clean data of security in RStudio which includes 'Open', 'High', 'Low' and 'Close' price of security.
- Find Mid-Price using 'High' and 'Low' price. After that calculate SMA(Mid-Price,5) and SMA(Mid-Price,34) and Calculate AO.
- Find current trend using AO.
- Find Up Fractal and Down Fractal using 'High' and 'Low' price.
- Identify Elliott Wave pattern using current trend and Fractal.

5.4. RESULT

Using the above procedure, we can identify Elliott Wave Pattern using daily, 'Open', 'High', 'Low' and 'Close' price of security. For the demonstration purpose, Table 1, Table 2, Table 3, Table 4 represent one Bullish and Bearish wave of RELIANCE.NS, AARTIIND.NS, DRREDDY.NS and GRAPHITE.NS respectively. In the outcome, we find 5 impulse wave points through pattern identification and give the prediction for 3 corrective wave point namely A, B, and C. In other words, we find the main impulse wave of Elliott Wave pattern and give the prediction for the corrective wave. If the impulse wave is Bullish, then upcoming corrective wave is Bearish and vice a versa.

Table 1

Table 1 Bullish and Bearish Wave (RELIANCE.NS)							
Date	High	Low	Bullish Wave	Date	High	Low	Bearish Wave
3/25/2020	1140.73	954.2	W1	5/4/2018	955.64	941.07	W1
3/30/2020	1064.7	1010.42	W2	5/15/2018	990.6	967.47	W2
4/15/2020	1224.39	1132.26	W3	5/23/2018	917.3	900.61	W3
4/21/2020	1240.24	1153.07	W4	5/29/2018	919.28	905.81	W4
4/24/2020	1480.91	1334.54	W5	5/30/2018	914.53	898.08	W5

Figure 3
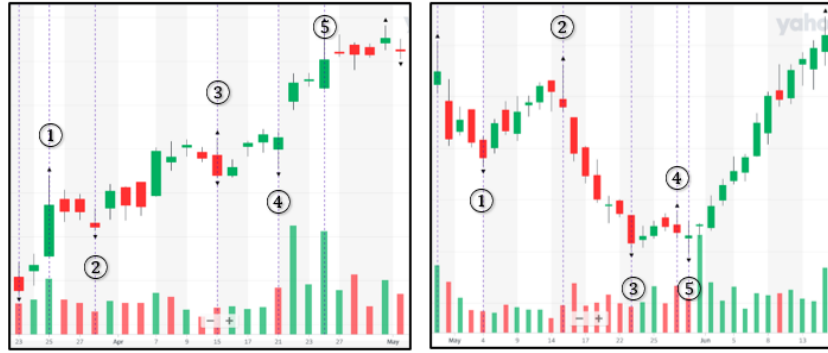
Figure 3 Graphical representation of Table 1

Table 2

Table 2 Bullish and Bearish Wave (AARTIIND.NS)							
Date	High	Low	Bullish Wave	Date	High	Low	Bearish Wave
9/26/2016	153.81	151.17	W1	7/5/2007	10.63	9.67	W1
9/29/2016	149.92	141.59	W2	7/10/2007	11.94	10.91	W2
10/5/2016	166.93	162.8	W3	8/10/2007	7.05	6.62	W3
10/7/2016	165.47	160.37	W4	8/16/2007	7.83	7.33	W4
10/19/2016	184.65	178.9	W5	8/24/2007	7.01	6.6	W5

Figure 4
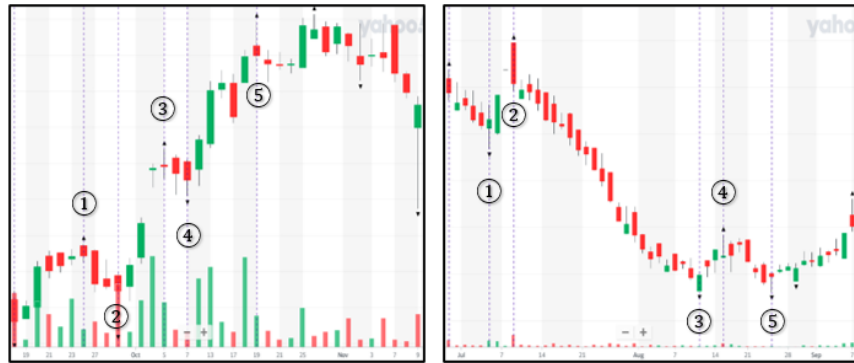
Figure 4 Graphical representation of Table 2

Table 3

Table 3 Bullish and Bearish Wave (DRREDDY.NS)							
Date	High	Low	Bullish Wave	Date	High	Low	Bearish Wave
8/18/2021	4755.04	4675	W1	11/25/2014	3595	3460	W1
8/24/2021	4595.7	4445.7	W2	12/1/2014	3666.25	3602	W2
9/6/2021	4943.29	4871.45	W3	12/8/2014	3405.55	3310.55	W3
9/7/2021	4925.95	4855.54	W4	12/11/2014	3448	3331	W4
9/16/2021	4996.5	4916.54	W5	12/17/2014	3213	3057	W5

Figure 5

Figure 5 Graphical representation of Table 3

Table 4

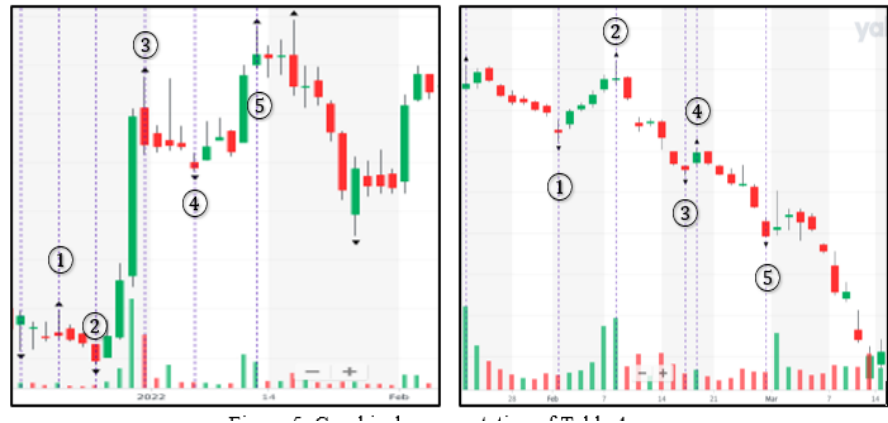| Table 4 Bullish and Bearish Wave (GRAPHITE.NS)							
Date	High	Low	Bullish Wave	Date	High	Low	Bearish Wave
12/22/2021	424	409.75	W1	2/3/2020	293.89	280.54	W1
12/27/2021	407	396	W2	2/10/2020	329.79	316	W2
12/31/2021	544	503.85	W3	2/18/2020	266	260	W3
1/6/2022	505	495.29	W4	2/19/2020	276.89	266.1	W4
1/13/2022	569	548	W5	2/28/2020	235	222	W5

Figure 6

Figure 6 Graphical representation of Table 4

6. CONCLUSION

In this paper, we have successfully used the Fractal Indicator and Awesome Oscillator for Elliott wave formation. Using R programming we find five wave points of the Elliott wave's main impulse wave. We have applied this to the index NIFTY100 and top 100 securities of the NSE. We took data from January 2005 to April 2022. We attempt to predict three wave point of main Corrective Wave which is correct in most cases, but there are exceptions like, in Figure 6, identification of Bearish wave

points 5 is wrong so prediction of corrective is not correct. Such instances call for further research into this area. In this work we have worked on only one standard wave pattern of Elliott Wave, so we get less wave pattern on security price. Further improvements on this works are the scope for future research.

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