

A Visual Tool to Support Technical Analysis of Stock Market Data

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ABSTRACT

A stock market investor relies on two schools of analysis of market behavior to determine a trading strategy: Technical Analysis and Fundamental Analysis. Fundamental Analysis is based on the study of the fundamental data of a company and more directed to long-term investments, not taking into account small short-term price oscillations. On the other hand, Technical Analysis is mostly used for mid and short-term investments and is based on the study of past price behavior through the use of statistical tools and price history charts, taking into consideration the hypothesis that prices form patterns and reflect all the relevant information about a company and about the psychology of other investors. The application of Technical Analysis requires a computational system capable of displaying price history charts and providing tools to be used with them. This paper presents a prototype for a portable, extensible and easy-to-use tool for desktop/laptop and handheld computers that provides the investor with techniques for the visualization of stock market data. Classical visualization techniques and tools, such as Line, Bar, Candlestick and Point and Figure Charts, as well as extra tools, such as candlestick pattern recognition, are available as built-in functions, but new tools and visualizations can be easily added. The software was built with the .NET and .NET Compact frameworks and utilizes XML to store the data set.

Categories and Subject Descriptors

J.1 [Computer Applications]: Administrative Data Processing – Financial.

General Terms

Design, Experimentation, Human Factors.

Keywords

Information Visualization, Stock Market, Technical Analysis

1. INTRODUCTION

A stock market investor relies on two schools of analysis of

market behavior to come up with a trading strategy: Technical Analysis and Fundamental Analysis.

Fundamental Analysis aims at finding a stock's worth through the study of its company's financial situation and prospects (its fundamental data). It is concerned with a company's income and expenses, management and position in its industry and is thus interested in studying company reports and news items relevant to the company and the market in order to find out if its stock is over or undervalued and predict how it will be in the future. Fundamental Analysis is particularly interesting for long-term investors, since its focus is on a company's intrinsic price, not its market price, which is influenced not only by a company's fundamental data but also by market psychology.

Contrary to Fundamental Analysis, Technical Analysis attempts to predict future price oscillations by analyzing past price behavior with the use of statistical tools and price history charts. It is based on the premises that prices form repeating patterns and are the reflection of every possible bit of information available (including fundamental data and the psychology of investors). The tools of Technical Analysis, which include statistical indicators and simple tracing tools, are concerned with detecting these patterns in the past and figuring out when they might happen again in the future, allowing the investor to see when a trend is about to begin or end and build a strategy based on this information. Technical Analysis attempts to detect not only long-term trends that result from fundamental data, but also short-term oscillations and is so interesting to mid and short-term investors. The application of Technical Analysis, though, requires the use of a computational system capable of displaying price history charts and providing tools to be used with them.

Most commercial stock market charting software, such as Equis MetaStock™ [1] and Tradestation® [2] are geared at the professional technical analyst and are too complex and expensive for the nonprofessional user, who also rarely uses most of the features available. Most commercial software also feature only the most common chart types (such as bar charts and candlesticks [3]) and don't provide enough extensibility for new visualization types to be included, even though some, such as Metastock™, also feature a handful of more alternative chart types.

There are also very few options for handheld users, who must rely mostly on very feature-limited software. One of the few reasonably complete packages for handhelds is MetaQuotes Software's MetaTrader 4 Mobile [4], which contains many investing tools, but very limited visualization features and can

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only be used for a few of the world's markets, along with not being very user-friendly.

This paper presents a prototype of a simple easy-to-use stock market chart visualization system that allows nonprofessional users with a basic knowledge of Technical Analysis to plot and study different types of stock market charts on their desktop/laptop or handheld computers. The software was designed with extensibility in mind, so that new tools and forms of visualization can be easily added. It was built with the .NET and .NET Compact frameworks and uses XML to store the data it manipulates.

2. SOFTWARE DESCRIPTION

2.1 Requisites

Before development began, three main goals were established that the software should ideally fulfill:

- **Portability.** The software should be able to run on multiple platforms, including handhelds.
- **Simple and Easy to Use.** The software should include only the features a nonprofessional user would actually use and they should be easy to access and intuitive in their application.
- **Extensibility.** One should be able to easily add new tools and visualization forms to the software, thus expanding its functionality.

Along with these features, the software should include built-in support for the basic Technical Analysis chart types and tools and should allow a user to make, store and retrieve different studies on the same set of data. The software should also be able to acquire data from as many sources as possible.

2.2 Notes on the Implementation

Initially the project was developed in Java especially to fulfill the portability requisite, but it was eventually ported to the .NET framework due to performance issues and easier portability to handheld computers through the use of the .NET Compact framework.

The software is very extensible, allowing new tools and visualization types to be added as plug-ins, which can be creating by simply extending a class.

The user interface of the software is geared at making the tools and chart types easily accessible and intuitive to use. It is still a work-in-progress, so the current version still has room for improvement.

2.3 Data Format and Acquisition

It is essential for a stock market chart visualization package to be able to acquire the data it uses from as many different sources as possible and it might also be useful to export an analysis made in it so that it can be used in another tool. So, all stock and chart data are stored in XML files that can be easily converted to and from other formats. In its current form, the software provides a simple parser to convert text files with stock data formatted as in Figure 1 to the XML files used by the software. In the future, more conversion tools will be available.

Date Time Open High Low Close Volume
(dd/mm/yyyy) (hh:mm)

Figure 1. Each line of a source text file should be formatted as the figure above.

An example of what a properly formatted text file should be like can be seen in Figure 2.

```
21/09/2001 00:00 40.30 43.11 40.30 42.80 250115.75
24/09/2001 00:00 42.51 42.56 40.46 40.74 2187268
25/09/2001 00:00 41.10 41.18 38.93 39.65 2993691.5
26/09/2001 00:00 39.97 40.14 38.96 39.33 1619049.87
27/09/2001 00:00 39.33 41.10 38.85 40.62 1215838.25
28/09/2001 00:00 41.26 41.26 39.73 39.85 910637.87
```

Figure 2. Example of a properly formatted input text file.

Charting with data acquired in real-time from a server is not yet implemented, but will be supported in a future version.

2.4 Using the Software

The first step for a user is to convert the data of the financial asset (security) that is to be visualized to the format used by the system. If the source data is in a text file formatted as in Figure 1, the user can do this from within the software by clicking on the "Create New Security from Text File" item of the File Menu. A dialog screen will pop up asking for the name and symbol of the security and for the path of the source text file and the target XML file.

To visualize a security's chart, the user must click the "New Chart" item of the File Menu. A dialog will pop up, in which a source security and a chart type must be selected. The chart is then displayed and the user can navigate and study it through the use of its related toolset.

A chart analysis may be saved for posterior work by selecting the "Save Chart" option of the File Menu. With this, a new XML file containing information pertinent to the chart and its study is created. This chart study may be reopened at a later time by simply selecting the "Open Chart" item of the File Menu and selecting the chart's XML file.

As many charts can be created for each security as the user wants, so that many different studies can be made on the same set of data.

In a future implementation, the system will also be able to create charts based on not only one security, but also on groups of related securities.

3. CHARTS AND TOOLS

The software provides built-in the four charts most used by technical analysts: Line Chart, Bar Chart, Candlestick Chart and Point and Figure Chart. All the charts were implemented as plug-ins, which are written classes that extend a root Chart class that provides default data structures and methods for basic chart navigation, such as zooming and resizing the canvas onto which all is drawn both horizontally and vertically. Each chart type is associated with a set of tools that might include both classical Technical Analysis chart tracing tools, such as Trend Lines and Fibonacci Retracements and Expansions, and a few extra features, such as simple a pattern recognition system for Candlestick Charts. New toolsets can also be added to the software so that they can be applied to new and old visualization types. Information about Technical Analysis charts and tools can be found in [3], [5] and [6].

3.1 Line Chart

The Line Chart shows the variation of the price of a stock in time. It is plotted by tracing a line that connects the closing price of each period (which could be a day, a week, a minute – any predefined amount of time).

3.2 Bar Chart

The Bar Chart builds on the Line Chart, but instead of showing simply the closing price of a period, it shows a bar (Figure 3) that expresses the period's highest, lowest and closing prices. Bars are placed one next to the other, chronologically and with no line connecting them.



Figure 3. Example of a Bar Chart's bar

3.3 Candlestick Chart

Currently the most popular chart type, the Candlestick Chart builds on the bar chart, adding also a period's opening price. An example of a Candlestick Chart bar (called a candlestick) is shown in Figure 4. Candlesticks are arranged in the same way as the bars: one next to the other, chronologically and with no line connecting them. Candlesticks with closing prices higher than opening prices (*bullish*) are called “white candlesticks” and are usually left unfilled. Candlesticks with closing prices lower than opening prices are called “black candlesticks” and are usually filled with black. The lines on the top and bottom of the candlesticks are called “shadows” and represent the extreme prices of the period (highest and lowest).

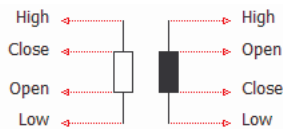


Figure 4. White and black candlesticks

3.3.1 Types of Candlesticks

Candlesticks can have long or short bodies, long shadows, short shadows or no shadows at all. All of these traits reveal information that can be useful to the investor. The main candlestick types are described below.

3.3.1.1 Long and Short Candlesticks



Figure 5. Long and short candlesticks

Long and short candlesticks can be seen in Figure 5. A white long candlestick shows a predominance of buyers while a black long candlestick indicates a predominance of sellers. Short candlesticks mean little market movement and consolidation.

3.3.1.2 Marubozu (Long Body)



Figure 6. Marubozu

Seen in Figure 6, a *marubozu* is a candlestick with no shadows. It shows an exceptional presence of buyers (in case of a white *marubozu*) or sellers (in case of a black *marubozu*) in the period. It represents a totally *bullish* (up-trending) or *bearish* (down-trending) price movement.

3.3.1.3 Spinning Tops



Figure 7. Spinning tops

Spinning tops (Figure 7) are a sign of indecision. It shows that the price oscillated across a large range but settled near to the opening. If a spinning top is found after a considerable movement, it might indicate that the current trend is losing its strength.

3.3.1.4 Long and Short Shadows



Figure 8. Long and Short Shadows

Candlesticks with long and short shadows can be seen in Figure 8. A black candlestick means that buyers dominated the movement, but were eventually beaten by sellers. If a black candlestick with long and short shadows is found on a relative high of the chart, it might indicate that the up-trend is over the down-trend is about to begin. A white candlestick is analogous to the black.

3.3.1.5 Doji



Figure 9. Doji

A *doji* (Figure 9) happens when the opening and closing prices are virtually the same. It is a sign of indecision and depending on where they are found, they might indicate a trend reversal.

3.3.2 Candlestick Patterns

Candlesticks are particularly interesting for the patterns that they form, which can be used as a tool in foreseeing what the next price oscillation will be. Candlestick patterns usually are more influential when found on relative highs or lows of the chart and they can be formed by one or more candlesticks.

The software includes a pattern recognition system that can detect simple candlestick patterns. Currently, two of these patterns are supported, the *harami* and the engulfing pattern. More will be available in the future.

The detected patterns are demarcated directly on the Candlestick Chart analyzed in the spots where they were found.

3.3.2.1 Harami



Figure 10. Harami

The *harami* is a simple trend-reversal pattern. It is formed by a long and a short candlestick and the short one's price range must be completely within the long one's body's price range (Figure 10). The *bullish* (up-trending) pattern consists of a long white candlestick followed by a short black one. The *bearish* (down-trending) pattern consists of a long black candlestick followed by a short white one.

3.3.2.2 Engulfing Pattern



Figure 11. Engulfing pattern

The engulfing pattern (Figure 11) is the opposite of the *harami*: it is formed by a shorter candlestick followed by a longer candlestick that has a body with a price range wider than the entire price range of the shorter candlestick – the longer bar literally *engulfs* the shorter bar. When the longer candlestick is white, a *bullish* pattern is formed. When the longer candlestick is black, a *bearish* pattern is formed.

3.4 Tracing Tools

To analyze a chart, the user can apply classical technical analysis tracing tools on it. The software already provides built-in tools for tracing support and resistances, trend lines and Fibonacci Retracements and Expansions.

3.4.1 Support and Resistance

A support is a price level at which for some reason buyers show up, keeping the price from falling (literally supporting the price). A resistance is analogous to the support, being a price level at which sellers show up and keep the price from rising. A support or resistance is demarcated by the user on the chart by tracing a simple horizontal line at the prices in which they are found.

3.4.2 Trend Lines

A trend line is a straight line that connects at least two consecutive price points and then extends into the future. An uptrend line is traced connecting relative lows while a downtrend line is traced connecting relative highs. Uptrend lines work analogously to support lines, keeping the price from falling below it, while downtrend lines work analogously to resistance lines, keeping the price from rising above it. A trend reversal happens when a trend line is crossed by the price.

3.4.3 Fibonacci Retracements and Expansions

$$f(n) = f(n-1) + f(n-2)$$

Figure 12. Formula for calculating Fibonacci numbers

The ratio of two consecutive Fibonacci numbers, which can be calculated from the function in Figure 12, converge to the constant 1.6180339887498, which is known as *phi*, or the Golden Section. This constant and the Fibonacci numbers appear everywhere in nature's chaotic patterns, such as in the branch structure of trees, the spiral of a snail's shell and the proportions of the human body and face. Unexpectedly, they also appear in the stock market: for instance, after an up-trending price movement, the price tends to fall 61.8% of the first movement's price. The constant *phi* can then be used to find future levels of support and resistance and the software provides this tool to allow the investor to predict price oscillations.

4. CONCLUSION

We presented here the prototype of a tool for the visualization and manipulation of stock market data, aiming at helping the nonprofessional investor in the application of Technical Analysis in the elaboration of trading strategies. The software includes most of the classical Technical Analysis charts and tools and allows the addition of new ones, providing an easy-to-use interface to access these features. It allows for easy communication with other software through the use of XML technology and its port for handheld computers provide them with tools previously only available to the desktop/laptop. The system serves more as the first step for the development of new visualization techniques, providing the basic structure on which these tools can be built.

4.1 Future Work

In the future, support for technical indicators (such as RSI, MACD, Stochastic, etc.), more visualization tools and a new interface will be integrated into the system. Real-time acquisition of data will also be implemented so that the software can be used for intraday trading.

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