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| RESEARCH ARTICLE

Financial Analysis Dashboard Application for Stock Exchange Listed Companies

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| ABSTRACT

The current paper aims to outline the development of a web application to streamline the process of analyzing listed companies in a simpler, more concise and more user-friendly way, helping financial analysts make better decisions when placing a trade. The application offers users the ability to obtain financial analysis through a single company search as well as the ability to record transactions to account for price changes. The fundamental analyzes that the application offers start with the analysis of solvency, cash conversion cycle, performance, positioning, liquidity and bankruptcy risk, using public financial data of the companies as well as the current situation of the news and changes they have had place on the market in the last 24 hours. In the case of technical analysis, we can identify indicators that follow the analysis of the share price, the movements, the trend as well as the trading volume.

| KEYWORDS

Financial analysis, Web application, Dashboard application, Stock exchange

| ARTICLE INFORMATION

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1. Introduction

The analysis of financial statements has an impact on the decision to buy or sell the shares, implying the possibility of developing a portfolio of both long-term and short-term investments. Of course, the decision is based on the financial indicators and their interpretation, but also the current external situation, such as news and public actions, to obtain a clear vision of the company but also the determination of future forecasts. Therefore, we consider it useful to develop a financial analysis web application that will allow reaching clear perspectives on the health of a company as well as making better decisions in the case of trading on the market.

We have tackled the quantitative as well as the qualitative approach. On the quantitative side, we find historical price analysis where indicators such as SMA, EMA, RSI, and VOLUME can help determine future price movements. However, here we also identify the analysis of financial statements in the determination of financial indicators on a certain economic factor, such as liquidity, solvency, cash flow, bankruptcy risk, positioning and performance. On the qualitative side, qualitative data such as textual information, especially news, the impact of the stock's rise or fall in the last 24 hours becomes paramount in making a market decision.

The developed web application enhances the financial analysis process, offering the user the possibility to obtain the calculated indicators as well as a dashboard of their evolution through a single search of the company listed on the stock exchange. Moreover, our developed web application provides global information on the movements that have taken place on the market as well as the most important news of the last days and the ability to record the simulation of fictitious transactions to take into account companies that would register an increase or a decrease following the financial analysis performed.

The proposed financial analysis application is aimed first and foremost at financial analysts, traders and investors, but also at people who are starting a career in finance and want to obtain explanatory financial analyses that combine both fundamental and technical analysis.

According to the results obtained by (Nti, 2020) in identifying the most frequently used analysis, it was concluded that 66% of the analyzed documents were based on technical analysis, while 23% were based on fundamental analysis and, respectively, 11% on both analyses.

These results demonstrate the fact that most people who invest in the stock market are much more focused on technical analysis, where trading is pursued and the desire to obtain a quick profit in a very short term. However, without a study of the financial statements of the company to which invest becomes very difficult and complex to predict the movements in the market if a long-term investment or the creation of an investment portfolio is desired.

Of course, a combination of these two analyses increases the potential and chance of achieving better results in the market. Thus, our developed financial application combines both solutions, giving the user the opportunity to see and interpret things from different perspectives, both on a macro and micro level.

The proposed solution overcomes various other existing solutions on the market. The multitude of already existing solutions pursue a vision of fast real-time trading by offering indicators analyzed over short periods of time that do not display a complete analysis that would provide the opportunity to invest in the long term. Therefore, taking into account all the economic factors that can have a significant impact on the market performance of a company becomes the strong point of the proposed solution.

Our proposed web application provides a large amount of various financial analyses while extending the time period of the analysis that can be performed, these being carried out over the last four years. The visualization of data with the help of graphs is also integrated in the form of a financial dashboard that can be downloaded with all analyses and results performed.

The remaining work is organized as follows: Chapter 2 focuses on the background of the topic and the description of the theoretical aspects of financial analysis. Chapter 3 follows the description of the application architecture through the logical and technical aspects, while Chapter 4 details the specific technologies used in developing the application. Chapter 5 describes the implementation of the application, and finally, Chapter 6 addresses the conclusion and final remarks.

2. Background

Nowadays, the economic health of every expanding economy, country, or society is mostly determined by their market economies and stock prices, with the financial sector serving as the pivot (Nassirtoussi et al. 2014; Göçken et al. 2016). It is difficult to predict the evolution of financial markets due to a variety of uncertainties (such as general economic conditions, social factors, and political events at both the domestic and international levels) (Bisoi and Dash 2014; Rather et al. 2014; Lin 2018).

Fundamental analysis and technical analysis (charting) are the two main methodologies used for stock market prediction (Nassirtoussi et al., 2014; Ahmadi et al., 2018).

The technical analyst attempts to forecast the stock market by learning to read charts that depict past market prices and technical indications (Suthar et al. 2012; Ballings et al. 2015; Su and Cheng 2016). Historical stock prices are preprocessed, and relevant indicators are generated and displayed in charts. Simple-moving average (SMA), exponential moving average (EMA), moving average convergence/divergence rules (MACD), relative-strength index (RSI), and on-balance-volume (OBV) are some of the technical indicators discussed in (Anbalagan and Maheswari, 2014; Bisoi and Dash, 2014; Rajashree et al., 2014). According to (Almeida, 2020), technical analysis is a methodology for identifying price patterns and forecasting market dynamics. It makes use of historical price data, graphic tools, mathematical techniques, and econometric models. Recent studies (Deb et al. 2022; Eugster and Uhl 2022; Bazán-Palomino and Svogun 2023; Gradojevic et al. 2023) have combined technical indicators with statistical models, machine learning techniques, and other methods, demonstrating strong predictive capabilities across a variety of markets.

The fundamental analysis predicts future stock price based on the firm's economic standing, employees, the board of directors, financial status, the firm's yearly report, balance-sheets, income-reports, terrestrial and climatic circumstances such as unnatural or natural disasters, and political data (Anbalagan and Maheswari 2014; Ghaznavi et al. 2016; Agarwal et al. 2017). basic analysis being difficult to automate due to the unstructured nature of basic elements. On the other hand, the introduction of machine learning has enabled academics to automate stock market prediction based on unstructured data, resulting in higher prediction accuracy in some circumstances. Nonetheless, fundamental analysis is appropriate for long-term stock price movement but not for short-term stock price movement (Khan et al. 2011). The fundamental analyst analyzes stock price movement in three

dimensions based on publicly available information about the stock. Fundamental analysis, in general, assesses a company's financial health and future performance by figuring out the stock price that is closest to its actual value, based on three pillars: (i) an analysis of the company or asset; (ii) an analysis of the industry and market; and (iii) an analysis of economic and financial indicators, taking into account the significant role of economic behavior in both its micro and macroeconomic aspects (Almeida, 2022). According to (Wang et al. 2023), fundamental analysis can be used as a tool for analysis, introspection, and decision-making processes. It can also help provide a macro perspective of long-term investing philosophies.

3. Application Architecture

From the point of view of the levels implemented in the application, the application architecture is represented by three levels; thus, Figure 1 depicts the application architecture where we find the presentation level (client side), the application level (server side) and the database level (database). The technology used in the presentation layer is Angular, which makes HTTP requests to the WebAPI to retrieve data and services from the server side. The server side is represented by .NET WebAPI, which processes the client requests and interacts with the data layer to retrieve or update this data, where the data layer is represented by Entity Framework Core, that enables the interaction with the Microsoft SQL Server database.

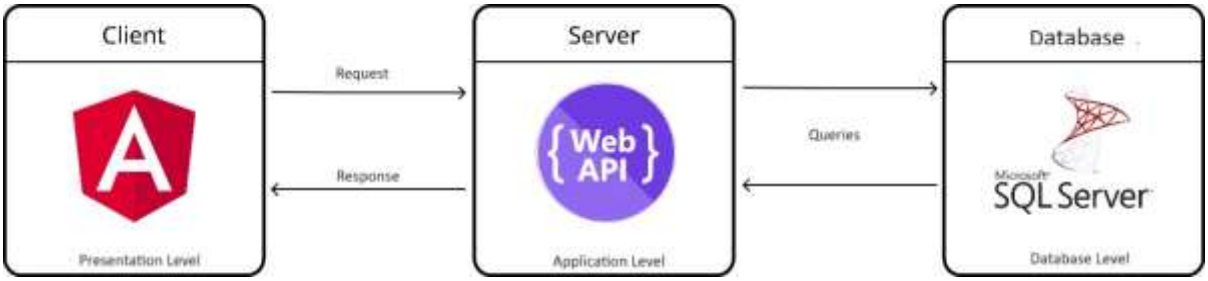

Figure 1 Application Architecture

For an efficient organization of the project source code, we have decided to use the MVC model, which gives a high flexibility of the application. The work conducted by (Singh, 2020) shows that the architecture of the MVC model is basically a three-layer architecture that separates the main features of the application. The first layer is related to the business logic of the application, the second layer focuses on the logical implementation of the user interface and the last layer acts as an intermediary between the model and the view, managing user input and updating the model as well as the views. The major advantage of MVC architecture is that it provides extremely efficient coupling between these three layers and facilitates parallel development. This means that each layer of the application is not dependent on each other.

In Figure 2, the WebAPI component diagram is depicted, which highlights the main software components and how they work together. The Entity Framework component includes the Database Context, which is responsible for managing the database connection. The Repository component includes encapsulation of the Transactions and Stocks entities, while Unity of Work provides a higher-level abstraction.

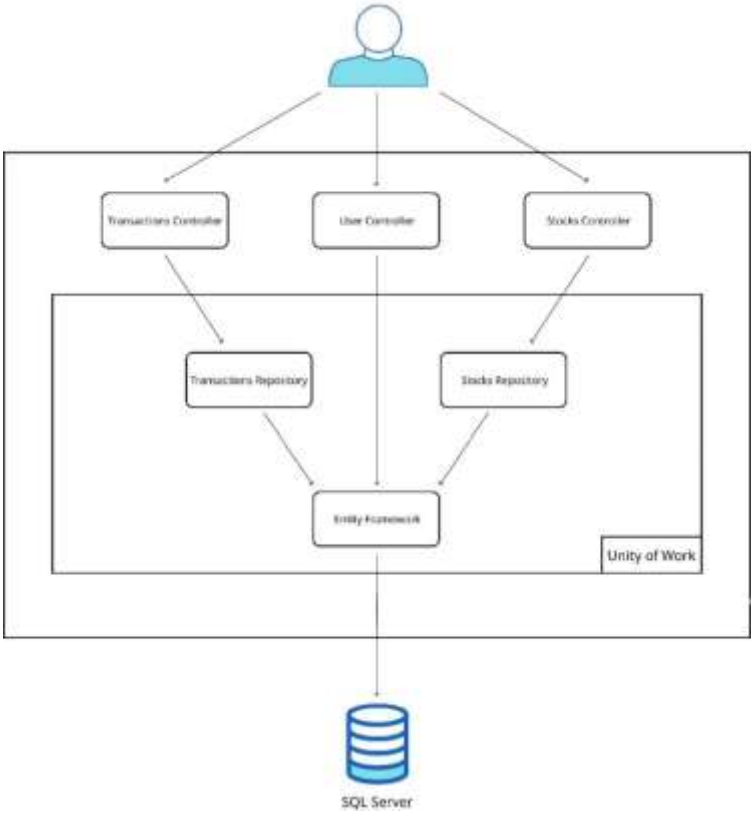

Figure 2 Component Diagram

4. Technologies and Tools

For project development, the IDE used was Microsoft Visual Studio Community, which provides several complex project templates. The programming language used is C#, an object-oriented programming language developed by Microsoft, being strongly typed. Hence, we use the LINQ data query technology, which enables querying data and manipulating the collections of objects in C#. The functionalities of this technology facilitated filtering and sorting certain data that is passed through the API to the front-end.

Thus, the type of project we developed is an ASP .NET WebAPI that allows building RESTful Web services, where APIs can be consumed by a variety of clients, including web applications, mobile applications, and other third-party applications by making HTTP requests. Authentication functionalities, token verification, and transaction recording facilities are enabled where these APIs become consumed by the front-end application. The data transfer format from the back-end to the front-end is JSON, which is simple to read and write (Microsoft, 2022).

The Swagger tool was used to test HTTP requests, which provides the description and documentation of APIs, as well as a suite of tools for generating client code for various programming languages and testing and validating web services. Thus, the API testing was performed with Swagger by simulating GET, POST, and DELETE requests.

The authentication functionality was implemented using ASP .NET Core Identity technology, which allows the development of authorization, password authentication, e-mail, and social network functionalities. It is configured using a SQL Server database to store user data, providing a layer of protection for that data (Microsoft Learn, 2022).

The Entity Framework(EF) Core ORM was used to create the database, which provides a programming interface to manipulate the database, tables and columns as objects. EF Core handles the implementation and execution of the SQL queries needed to access the database of data created. EF Core technology maps the objects in the tables, manages the relationships between them and offers the possibility of performing CRUD operations, which are consumed by the front-end. Moreover, EF Core comes with a set of functionalities, such as automatic database schema migration (Microsoft Learn, 2021).

To build the user interface, the Angular framework was used, which provides several functionalities and tools to develop interactive, performant and scalable web applications. It allows the creation of reusable components, and the main functionalities that have been implemented are routing, forms with predefined validations, but also certain services that can be used through dependency injection. The basic language used is TypeScript, which is considered a syntactic superset of the JavaScript language, which provides a layer of protection in identifying possible errors in the code (Angular, 2022).

On the side of creating and displaying the content on the page, HTML was used, and with the help of the directives provided by Angular, the elements could be manipulated in a dynamic way with few lines of code. Similarly, CSS was used to display and stylize these elements, as well as the Bootstrap framework, which contains a set of predefined components and styles to help create a modern and responsive interface (Jordana, 2022).

The technology used in rendering graphics is Apache ECharts, being a library written in JavaScript offering a series of functionalities to build complex and interactive graphs being compatible with most applications. According to the study conducted by (Li, 2018), the advantages of the library are ease of use because some graphics can be complex in data visualization, rich interactions offering a multitude of collections with different interactive graphics, as well as high performance, being able to handle a big amount data.

To implement the functionality of downloading financial reports and analyzes in PDF format, the jsPDF library was used, which allows the generation of PDF documents from HTML, CSS and JavaScript, providing functionality such as adding text, images, graphs, tables or a combination of the

5. Implementation

The functionality of creating a new account and the possibility of authentication was implemented based on a service-type component that performs HTTP Request connections based on the link generated by the WEB API application. Thus, in Code Snippet 1, we find the registration, account creation and logout methods, as well as authentication with the generated token that is kept in local storage as long as the user uses the application.

```
readonly financialsAPIUrl = 'https://.../api/IdentityUser';
constructor(private http: HttpClient) { }
loginUser(data: any): Observable<IUser> {
return this.http.post(this.financialsAPIUrl + '/login', data).pipe(
map((res: any) => {
localStorage.setItem('token', res.token);
localStorage.setItem('username', res.username);
this. user.username = res.username;
this.user.email = res.email;
return this.user;
})
);
}
registerUser(data: any) {
return this.http.post(this.financialsAPIUrl + '/register', data);
}
logoutUser() {
localStorage.removeItem('token');
}
```

Code Snippet 1. API authentication

Once authenticated, the main page shown in Figure 3 is displayed, where information on technical and fundamental analysis is available, as well as all financial analyzes with the indicators proposed for each individual economic factor. By allowing the user to access the computed indicators as well as a dashboard of their evolution by conducting a single search of the company listed on the stock exchange, the program facilitates the financial analysis procedure.

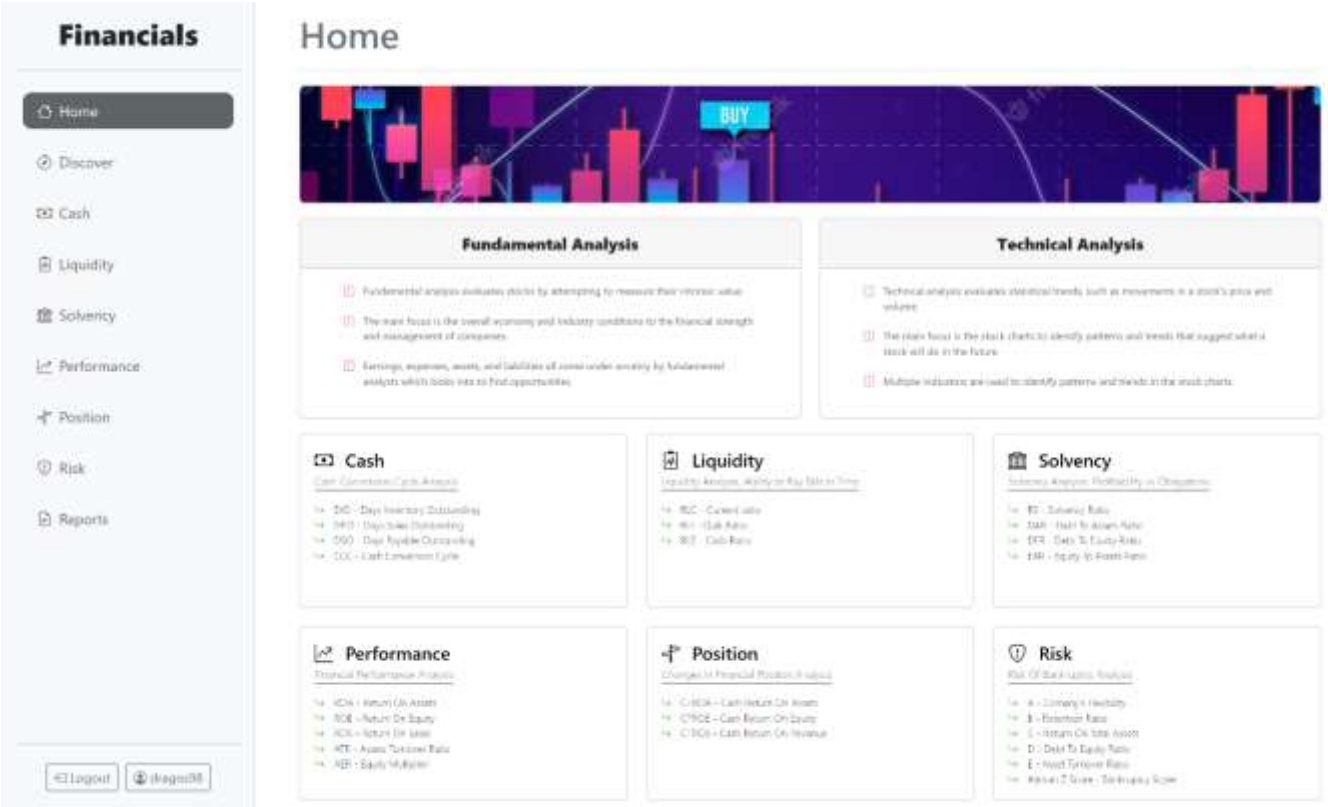

Figure 3 - Main Dashboard

For the user to be able to perform transaction records, we developed TransactionsController. In Code, Snippet 2 is listed as the TransactionsController that responds to the GET, POST, and DELETE methods. Here, we can see how the mapping of the results takes place within the POST method, where first, a Stock is added, and afterwards, the rest of the data related to the transaction. The code is easy to follow and read due to the implementation of the Unity Of Work and Repository patterns.

```
[HttpGet]
[Authorize]
public async Task<IActionResult> GetTransactions()
{
var transactions = await uow.Transaction.GetTransactionsAsync(userId);
return Ok(transactions);
}
[HttpPost]
[Authorize]
public async Task<IActionResult> AddTransaction(TransactionDto transactionDto)
{
var stock = new Stock
{
Symbol = transactionDto.Symbol,
Price = transactionDto.Price
};
uow.Stock.AddStock(stock);
await uow.SaveAsync();
var transaction = new Transaction
{
Result = transactionDto.Result,
Date = transactionDto.Date,
StockId = stock.Id,
UserId = userId.ToString(),
```

```
};
uow.Transaction.AddTransaction(transaction);
await uow.SaveAsync();
return Ok(transaction);
}
[HttpDelete("{id}")]

[Authorize]
public async Task<IActionResult> DeleteTransaction(int id)
{
uow.Transaction.DeleteTransaction(id);
await uow.SaveAsync();
return Ok(id);
}
```

Code Snippet 2 GET, POST, DELETE operations

The registration of transactions is based on the form filled by the user, the HTTP Request connections take place, and the GET, POST, and DELETE methods are implemented as a service. These can be traced in Code Snippet 3, where we also observe the use of the token that checks if the user who made a request has permission to add transactions.

```
readonly financialsAPIUrl = 'https://localhost:44398/api';
getTransactionsList(): Observable<Transactions[]> {
return this.http.get<Transactions[]>(
this.financialsAPIUrl + '/transactions',
{
context: new HttpContext().set(BYPASS_INTERCEPTOR, true),
...this.getToken(),
}
);
}
addTransactions(data: Transactions) {
return this.http.post(this.financialsAPIUrl + '/transactions', data, {
context: new HttpContext().set(BYPASS_INTERCEPTOR, true),
...this.getToken(),
});
}
deleteTransactions(id: number | string) {
return this.http.delete(this.financialsAPIUrl + `/ transactions /${ id}`, {
context: new HttpContext().set(BYPASS_INTERCEPTOR, true),
...this.getToken(),
});
}
```

Code Snippet 3 Source Code for CRUD API

The functionality of performing a financial analysis, shown in Code Snippet 4, is achieved through a request to the Yahoo Finance API, following completion by the user with the name of the symbol of the company desired to obtain the analysis.

```
getAnalysis(stockSymbol: string): Observable<any[]> {
let headers = new HttpHeaders({
'X-RapidAPI-Key': '0c05622b60mshb5bfb15bdb325a5p126430jsnad8533cae890',
'X-RapidAPI-Host': 'apidojo-yahoo-finance-v1.p.rapidapi.com',
});
let url = `https://apidojo-yahoo-finance-v1.p.rapidapi.com/stock/v2/get-balance-
sheet?symbol=${stockSymbol}&region=US`; return this.http.get<any>(url, { headers }).pipe(
catchError((error) => {
```

```
alert(error);
return [];
})
);
}
```

Code Snippet 4. Yahoo Finance API request

The analysis of financial statements implies the analysis of financial indicators on particular economic elements such as liquidity, solvency, cash flow, bankruptcy risk and financial performance. Figures 4-9, shown below, depict the dashboard features and the visual representation provided in the developed application.

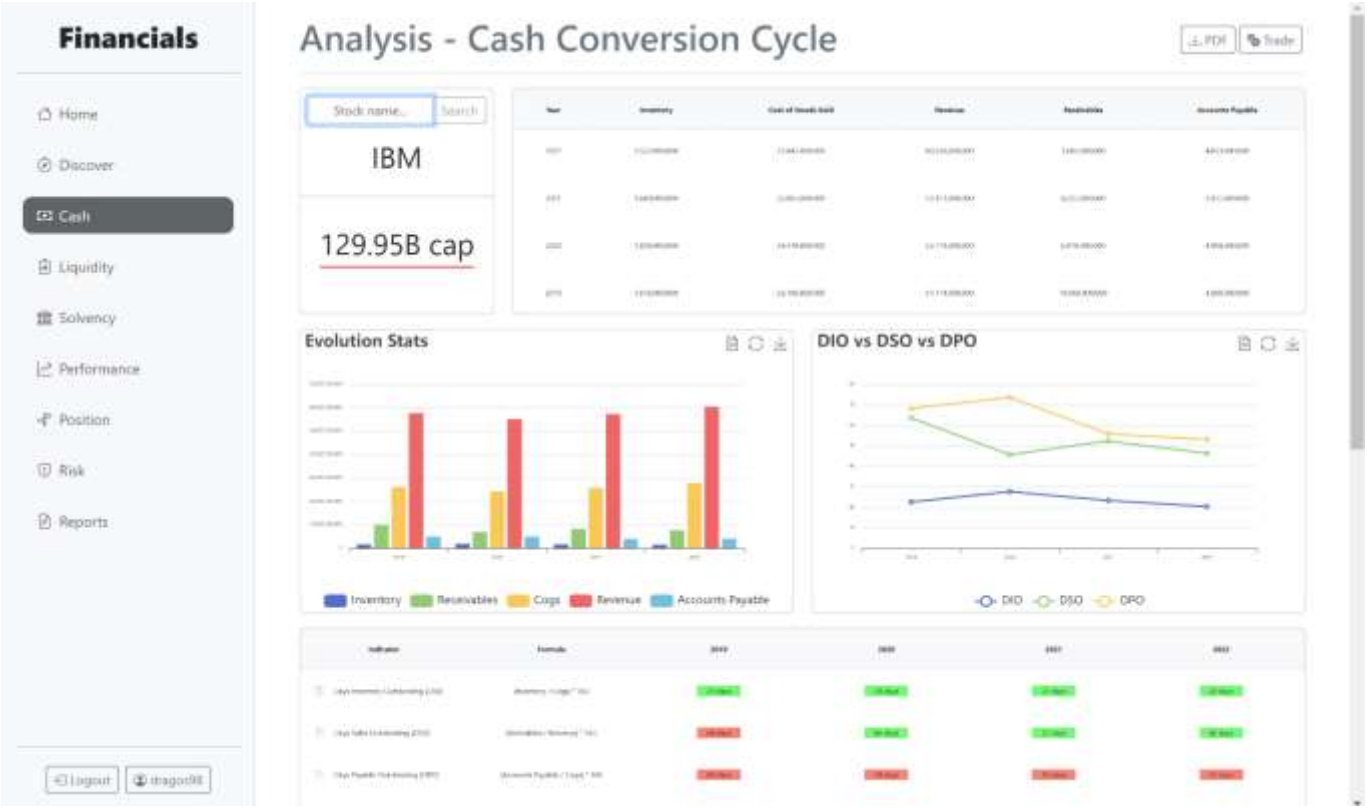

Figure 4 Cash Conversion Cycle

The Cash Conversion Cycle (CCC) measures how quickly a business converts the value of its generated goods and services into cash. This includes the complete process, from product manufacture and supply through sales and payment. All firms must always have enough cash available to reflect their liquidity position.

Liquidity is the effectiveness or simplicity with which an asset or security can be turned into immediate cash without impacting its market price.

The values of the profitability indicators should be interpreted in light of long-term trends, as well as in contrast to those of rival businesses and industry norms. Analysis of profitability enables determining how effectively a company uses its resources and how profitable it is. The profitability of equity is gauged by ROE (Return on Equity). The ability of a corporation to realize value from its investments is measured by ROA (Return on Assets). The return on sales (ROS) ratio assesses the profitability of a business in relation to sales. Since none of the indicators has a clear optimal level, it is important to evaluate each one's performance over time, to that of its rivals, and to industry averages.

Solvency is a performance metric that enables us to assess the financial stability of an organization. It specifically enables us to analyze whether the business can sustainably satisfy its financial responsibilities.

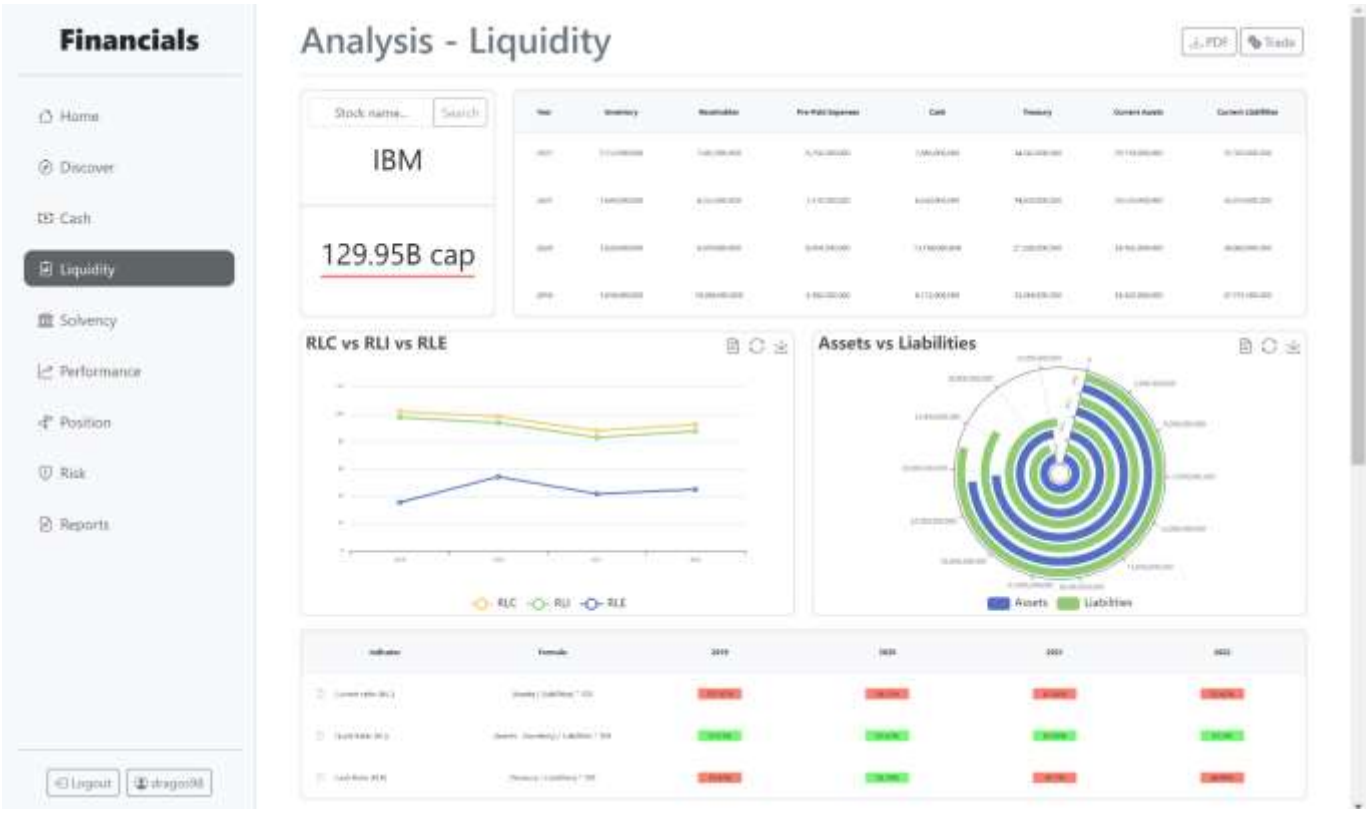

Figure 5 Liquidity

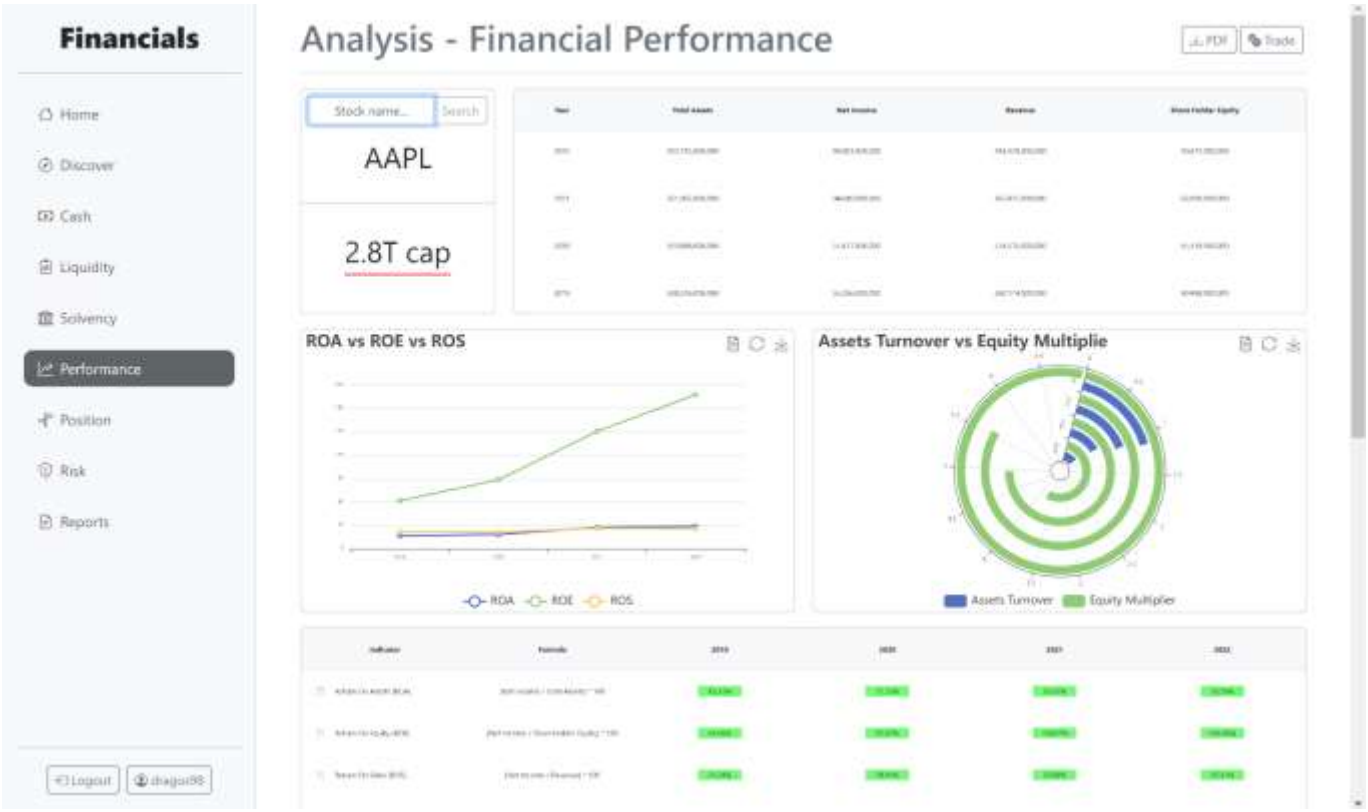

Figure 6 Financial Performance

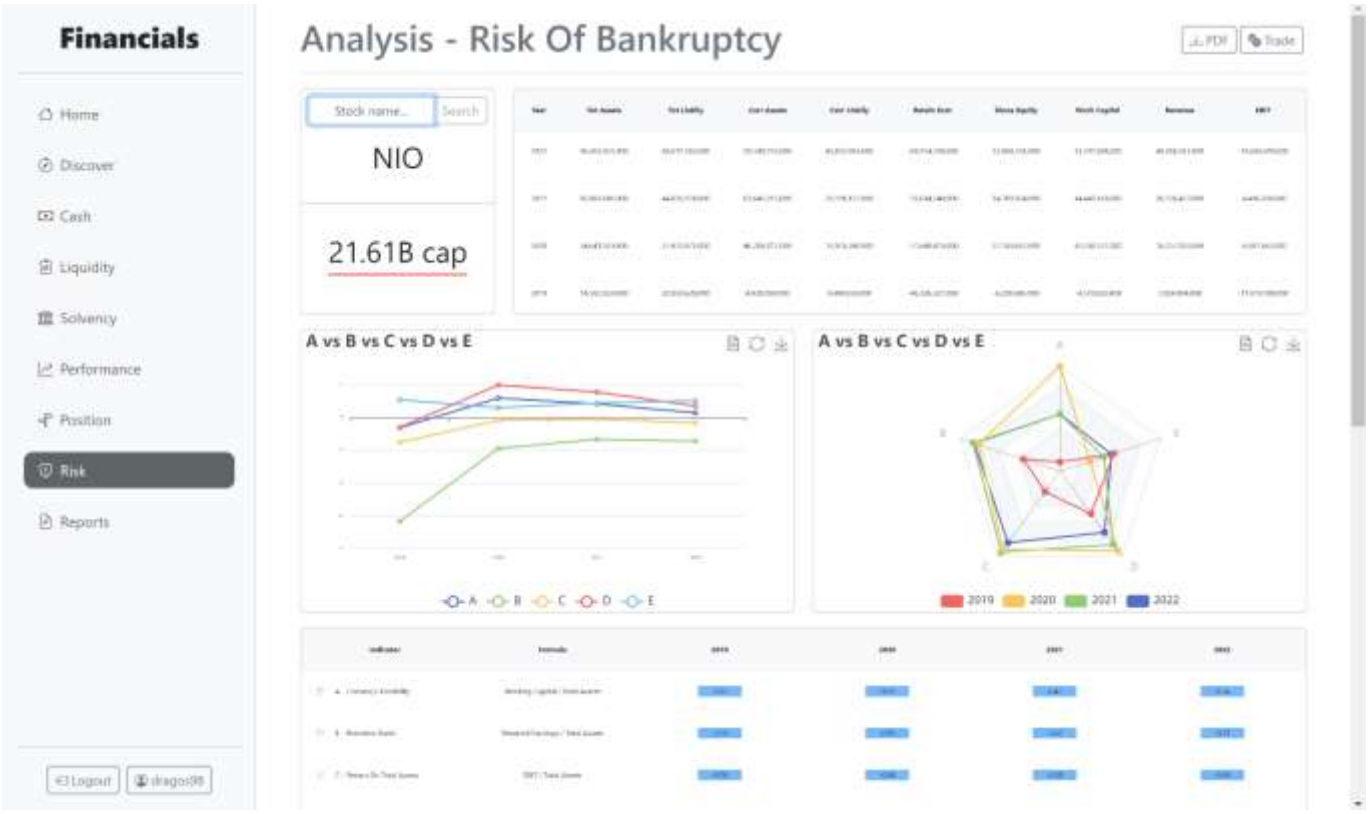

Figure 7 Risk of Bankrupcy

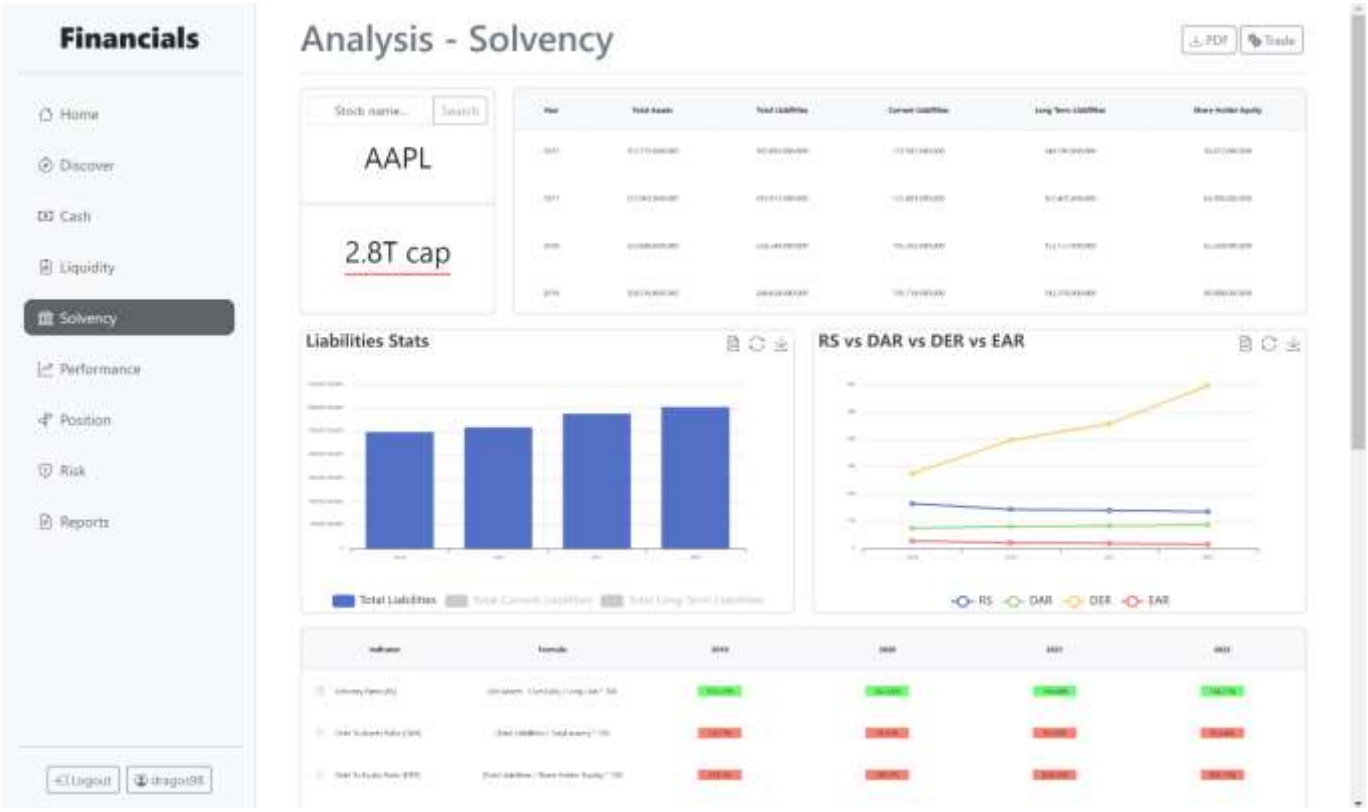

Figure 8 Solvency

6. Conclusion

In summary, this research paper has presented a financial analysis web application designed with the primary objective of facilitating comprehensive financial assessments based on various critical economic factors of companies. Our web application offers the financial audience, particularly stock market analysts and investors, a powerful tool for making informed decisions by evaluating key indicators related to solvency, cash flow, bankruptcy risk, performance, and liquidity. Through our analysis, users can gain valuable insights into a company's financial health and even forecast its share price.

Throughout this study, we have demonstrated the practicality and significance of our financial analysis platform. By leveraging technologies such as ASP .NET Web API and Angular, we have successfully implemented its current functionalities, demonstrating their utility in the financial domain. Our contribution lies in providing a user-friendly, data-driven tool that empowers financial professionals and investors with actionable insights for more informed decision-making.

However, it is essential to acknowledge certain limitations in our application. A noteworthy constraint is the reliance on constantly updated financial reports. If a company lacks publicly available data for any of the last four years, our analysis cannot be conducted. This limitation underscores the need for improved data management solutions, including the integration of a financial API that can provide frequent and timely updates for comprehensive analysis.

Looking ahead, several promising avenues for future research and development emerge. Firstly, enhancing data management through a reliable financial API should be a priority, ensuring the uninterrupted availability of financial data for analysis. Additionally, we can envision expanding the application's capabilities by introducing features such as a community forum for investors to share real-time financial analysis, integration with a brokerage platform for simulated or actual trading, and the incorporation of advanced technical analysis tools and indicators for more sophisticated chart analysis using Japanese candlesticks. Furthermore, providing users with customization options for graphics would enhance the platform's flexibility and user experience.

In conclusion, our financial analysis web application represents a valuable resource for stock market analysts and investors. While acknowledging its limitations, we anticipate that continued research and development in the suggested directions will further strengthen its capabilities and contribute to the evolving field of financial analysis tools. Ultimately, our study underscores the importance of accessible, data-driven solutions in the financial industry, facilitating more informed decision-making and a better understanding of company health and market dynamics.

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