IMPACT

(Broadridge Fixed Income Post-Trade Processing)

long internship Project Submitted

In partial fulfilment of the requirements for the award of the degree

Of

BACHELOR OF TECHNOLOGY

By

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Under the supervision of

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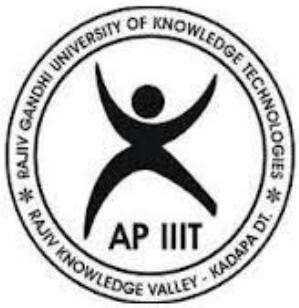

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CERTIFICATE

This is to certify that the project work titled “IMPACT**”** is a long internship submitted by C Shanmukha Vani (R170136) in the department of Computer Science and Engineering in partial fulfilment of requirements for the award of degree of Bachelor of Technology for the year 2022-2023 carried out the work under the supervision

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DECLARATION

I am **C Shanmukha Vani (R170136)** hereby declare that the project report entitled "IMPACT**"** done under the guidance of **Miss P.Udayasree** is submitted for major project of **Bachelor of Technology** in **Computer Science and Engineering,** is an authentic record of our own work carried out under the supervision of **C Shanmukha Vani,** the Major Project December 2022 - January 2023 at RGUKT – RK Valley.

We also declare that this project is a result of our own effort and has not been copied or imitated from any source. Citations from any websites are mentioned in the references.

The results embodied in this project report have not been submitted to any other university or institute for the award of any degree or diploma.

C Shanmukha Vani (R170136)
Date: 20-01-2023
Place: RK Valley.

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of any task would be incomplete without the mention of the people who made it possible and whose constant guidance and encouragement crown all the efforts success. We are extremely grateful to our respected Director, **Prof. K. Sandhya Rani** Mam for fostering an excellent academic climate in our institution. We also express my sincere gratitude to our respected Head of the Department **Mr.N. Satyanandaram** Sir for his encouragement, overall guidance in viewing this project a good asset and effort in bringing out this project. We would like to convey thanks to my project guide **Miss P.Udayasree** Mam for her guidance, encouragement, co-operation and kindness during the entire duration of the course and academics.

My sincere thanks to all the members who helped me directly and indirectly for the completion of project work. I express my profound gratitude to all our friends and family members for their encouragement.

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1.Introduction

1.1Organization Profile

Broadridge is a Fintech brokerage company founded in 2007 and founded by Tim Gokey, who is President and CEO of the company. The main business of Broadridge is as a service provider supplying public companies with proxy statements, annual reports and other financial documents, and shareholder communications solutions, such as virtual annual meetings.

The Company's segments include Investor Communication Solutions and Global Technology and Operations. The Investor Communication Solutions segment provides Regulatory Solutions, Data-Driven Fund Solutions, Corporate Issuer Solutions, and Customer Communications Solutions. This segment's business involves the processing and distribution of proxy materials to investors in equity securities and mutual funds, as well as the facilitation of related vote processing.

The Global Technology and Operations segment provides business solutions for capital markets and wealth and investment management firms. This segment offers advanced solutions that automate firms' transaction lifecycle, from desktop productivity tools, data aggregation, performance reporting, and portfolio management to order capture and execution, trade confirmation, margin, cash management, clearance and settlement.

1.2 Description of Internship

I have gone through 5-month long training program, in which they gained the knowledge on financial markets includes types of markets, different asset classes, bonds, equities, derivatives, mutual funds, forwards, options, futures etc. Along with the basic/advanced understanding on technical sessions which includes java, SQL, No SQL, Python, RPA, AWS, DEVOPS with some assignments. The trainings were followed by the complete understanding of various Broadridge products such as IMPACT, GLOSS, BPS, BPSA, FINPRO, GPTM etc

Details of the topics provided as below, which are covered in Interns Training Program.

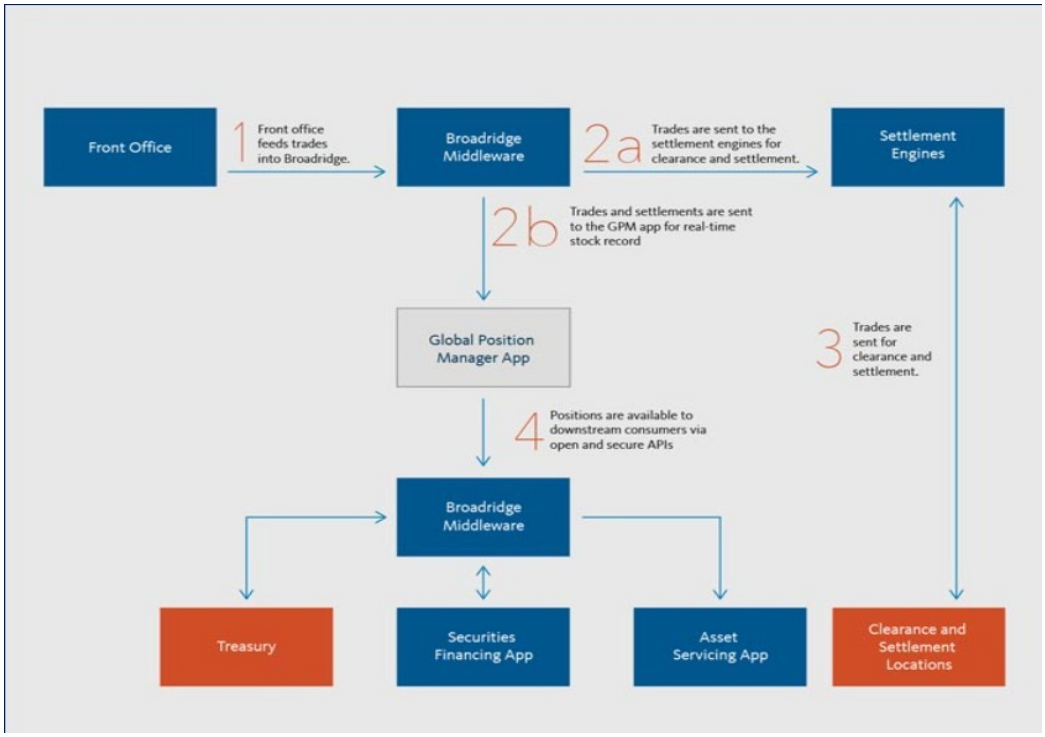
Business	Technology	Product
Financial Markets	SQL and NoSQL	Impact
Equity Markets	Python	C-Pro/Nina/BEES
Mutual Funds	Basic and Adv.Java	MBSE
US Bond Markets	Cloud Fundamentals	Fin Pro
Derivatives	AWS	BIMS
Wealth Management	Devops	RPA/FXL
Trade Life Cycle	SDLC & STLC	GPTM
	RPA	GLOSS
		Aspire
		BPS
		Ascendis

2.Overall Description

2.1 Product Perspective

Broadridge Financial Solutions' "Impact" product is to process applications for real-time U.S. and global fixed-income securities processing, clearing, reconciliation, settlement, and accounting. Broadridge Fixed-Income Post- Trade Processing (Impact) is an integrated online securities transaction processing system that offers the industry’s most comprehensive support for fixed-income trading.

Impact is Broadridge's integrated, online securities transaction processing system for fixed income trading. The impact system provides leading global financial institutions with trade capture and processing, as well as settlement and clearing functions for domestic and foreign fixed income instruments, including extensive support for mortgage-backed securities. Additionally, impact is a multi-currency and multi-entity system that provides real-time position and balance information, in addition to detailed accounting, financing, and repo functionality.



Impact Block Diagram

2.2 Product Functions

1.Trade Capturing

Trade capture is a process to book a transaction into a front-office trading system, such as inputting all trade details in the official book of record system, linking all reference data, and calculating profit and loss.

2.Trade Processing

The trade process is a stochastic process of transactions interspersed with periods of inactivity. The realizations of this process are a source of information to market participants.

3.Trade Clearance

Clearing is the procedure by which financial trades settle; that is, the correct and timely transfer of funds to the seller and securities to the buyer.

4.Trade Settlement

Trade settlement is a two-way process wherein the purchased securities are delivered to the buyer, and the seller receives cash.

4.Reconciliation

Reconciliation is the process of comparing transactions and activity to supporting documentation. Further, reconciliation involves resolving any discrepancies that may have been discovered.

2.3 Roles

User

User is nothing but Client who purchases professional services from a business. Customers buy products while clients buy advice and solutions.

2.4 Components of Impact

1. **Front-end Interface**: This is the user-facing part of the system, where traders and other users interact with the system to submit trade orders, monitor trade status, and access reports.

2. **Trading Platform**: This is the core trading engine that matches buy and sell orders and executes trades in real-time.

3. **Trade Capture and Confirmation**: This component captures and confirms trade details, including trade date, time, quantity, and price.

4. **Trade Matching**: This component matches trades between counterparties and reconciles trade details.

5. **Settlement Processing:** This component processes settlement instructions, including delivery versus payment (DVP) and payment versus payment (PVP) instructions, and ensures that securities and funds are delivered correctly.

6. **Risk Management**: This component monitors trades for potential risks, such as counterparty default or market volatility, and takes appropriate actions to mitigate those risks.

3.Tools

3.1 AS400

- In AS400, AS stands for **"Application System".**
- It is multiuser, multitasking and very secure system and hence is used for the industry which requires sensitive data to be stored and processed simultaneously.
- It has integrated the **DB2** database management system, menu-driven interfaces, multi-user support, security, communications, client–server and web-based applications.
- It is best suited for **mid-level industry** and hence is used in pharmaceutical industry, banking, malls, hospital administration, manufacturing, distribution industry, financial organization, e-commerce etc.
- The operating system for AS400 also got renamed with the rebranding. Initially, it was **OS/400** then **i5/OS** and then **iBM i** (Power system).
- Programming languages available for the AS/400 include RPG, assembly language, C, C++, Pascal, Java, Perl, Smalltalk, COBOL, SQL, BASIC, PHP, Python
- It has Object orientation i.e. everything that can be stored or retrieved on the system is known as an **"objects"**. AS400 can recognize only the object types that have been defined for it. It cannot identify any unknown objects that don't seem to be known. It adds extra security to the system.
- Another feature of AS400 is that it is very secure system making it to store sensitive data. It incorporates security at various levels. Any user can be limited to access/process only particular information on the system.

Companies that use AS400

1.California State University-Stanislaus

2.The North Face, Inc

3.Red Hat Inc

4.Dailymotion SA

User Interface of AS400

AS400 is a Green Screen Technology in which everything is controlled through commands. AS400 commands are CL (Control Language) commands. Most of them were written by IBM developers to perform system-level tasks like compiling programs, backing up date, changing system configurations, displaying system object details, or deleting them.

3.2 AS400 Control Language

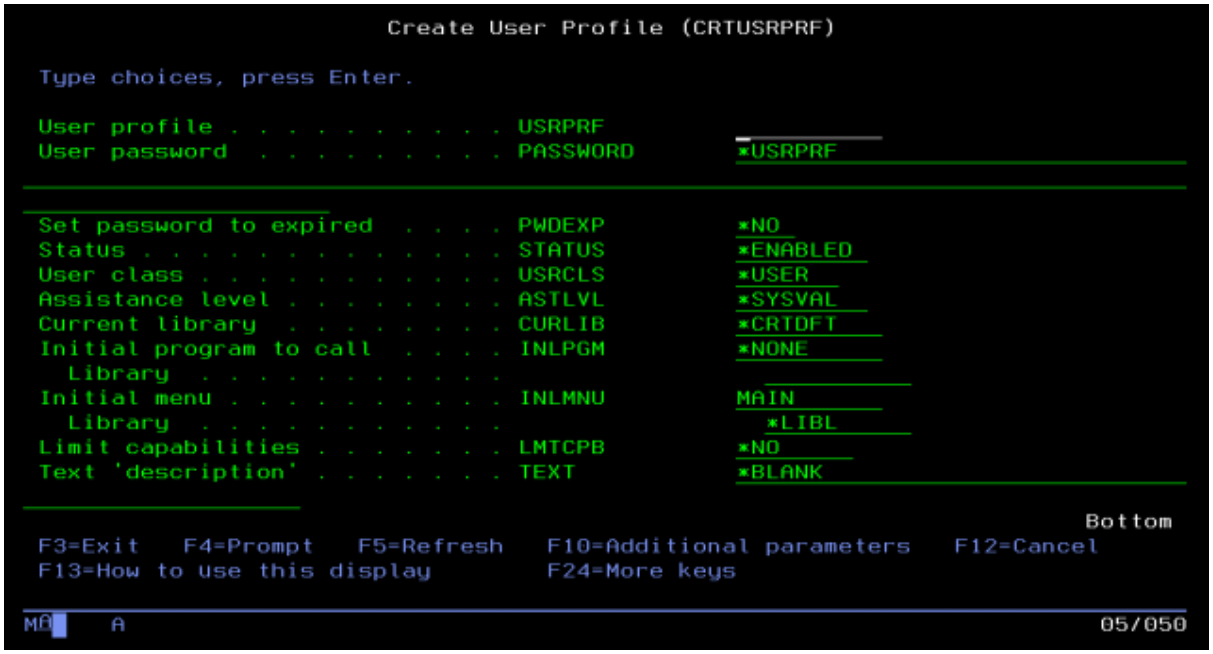
Control Language (CL) , an integral part of OS/400 , is a set of commands by which users control operations and request system-related functions on the AS/400.

The AS/400 Control Language (CL) is a scripting language for the IBM AS/400 mid range platform bearing a resemblance to the IBM Job Control Language and consisting of an ever-expanding set of command objects (*CMD) used to invoke traditional AS/400 programs and/or get help on what those programs do. CL can also be used to create CL programs (congruent to shell scripts) where there are additional commands that provide program-like functionality (GOTO, IF/ELSE, variable declaration, file input, etc. The vast majority of AS/400 commands were written by IBM developers to perform system level tasks like compiling programs, backing up data, changing system configurations, displaying system object details, or deleting them. Commands are not limited to systems level concerns and can be drafted for user applications as well.

Commonly used CL Commands

1. **WRKOBJ**_– It will give the details of an object from a library. If *ALL is specified in the library, it will display the list of all objects with that name in the system.
2. **WRKJOBQ**_– It will display the list of all the job queues in the system along with the number of jobs currently being processed in that job queue and status whether held or released and subsystem name.
3. **CRTUSRPRF**_– It will create a new user profile in the system with the details like user name, password, password expiry date, the initial menu option for the user, etc.
4. **STRSQL** – It will start an interactive SQL session where users can run their SQL commands.
5. **DSPOBJ** – Display information about an object, press f4 to get the detailed prompt, enter QBATCH and *JOBQ will display the details of the job queue object.
6. **CRTOUTQ**– It will create a new output queue if a user desires to process the job in a new output queue.

Example CL Command Execution



3.3 RPG Programming

RPG or Report Program Generator is a procedural, high-level programming language that you can use for your enterprise to create seamless applications on the as400 series or IBM i ecosystem.

Most top businesses globally use RPG programming in as400 to develop mission-critical corporate applications to achieve their business goals. It helps create solid and intuitive applications and helps the as400 RPG Programmers work in a professional programming environment to deliver better results. RPG programming is a programming asset that can help you level up your business applications and give your desired results.

Advantages

- When you use Java through WebSphere, it requires more hardware compared to RPG language, thus minimizing your maintenance and installation expenses.
- It provides one of the most interactive programming ecosystems and becomes easier to manage, upgrade, and integrate.
- It becomes easier to work in as400 with RPG. If you face any difficulties in the future with modern RPG, you just need to upgrade it.
- SMEs and other organizations don’t require fancy additional functionalities with PHP/WebSphere.

Example RPG Program

4.Volumes Database

The Volume Dashboard Project is a data visualization tool designed to help users gain insights into key performance indicators related to their business operations. The project involves collecting data from various sources and presenting it in a user-friendly dashboard that allows users to quickly and easily understand trends and patterns in their data. The dashboard includes interactive charts and graphs that allow users to drill down into specific data points and explore different aspects of their business performance. The goal of the Volume Dashboard Project is to provide users with a powerful and flexible tool for monitoring their business metrics and making informed decisions based on the insights provided by the dashboard**.**

The project involves collecting data from various sources, such as databases, spreadsheets, and APIs, and presenting it in a user-friendly dashboard that allows users to quickly and easily understand trends and patterns in their data. The dashboard includes interactive charts and graphs that allow users to drill down into specific data points and explore different aspects of their business performance..

The Volume Dashboard Project is a valuable tool for business owners, managers, and analysts who need to make informed decisions based on data insights. With this tool, users can monitor key performance indicators, such as sales revenue, customer satisfaction, and operational efficiency, and take proactive steps to improve their business performance.

5. Functional Requirements

The functional requirements of a volume dashboard project may vary depending on the specific needs of the business or organization. However, some common functional requirements for a volume dashboard project could include:

1. Displaying Volume Data: The dashboard should be able to display volume data in an easy-to-understand format. This could include bar charts, line graphs, or other visualizations.

2. Filtering Data: The dashboard should allow users to filter volume data based on various criteria, such as time periods, product types, or geographic regions.

3. Real-time Updates: The dashboard should be capable of providing real-time updates of volume data, allowing users to monitor volume levels as they change.

4. Alerting: The dashboard should be able to generate alerts when volume levels exceed or fall below predefined thresholds, allowing users to take timely action.

5. User Authentication: The dashboard should require users to authenticate themselves before accessing the data, to ensure data security and prevent unauthorized access.

6. User Access Controls: The dashboard should allow administrators to control user access to data, based on roles or permissions.

7. Integration with Data Sources: The dashboard should be able to integrate with various data sources, such as databases, APIs, or other systems, to retrieve volume data.

8. Exporting Data: The dashboard should allow users to export volume data to various formats, such as CSV, PDF, or Excel, for further analysis or reporting.

9. Customization: The dashboard should allow users to customize the appearance and layout of the dashboard to suit their preferences.

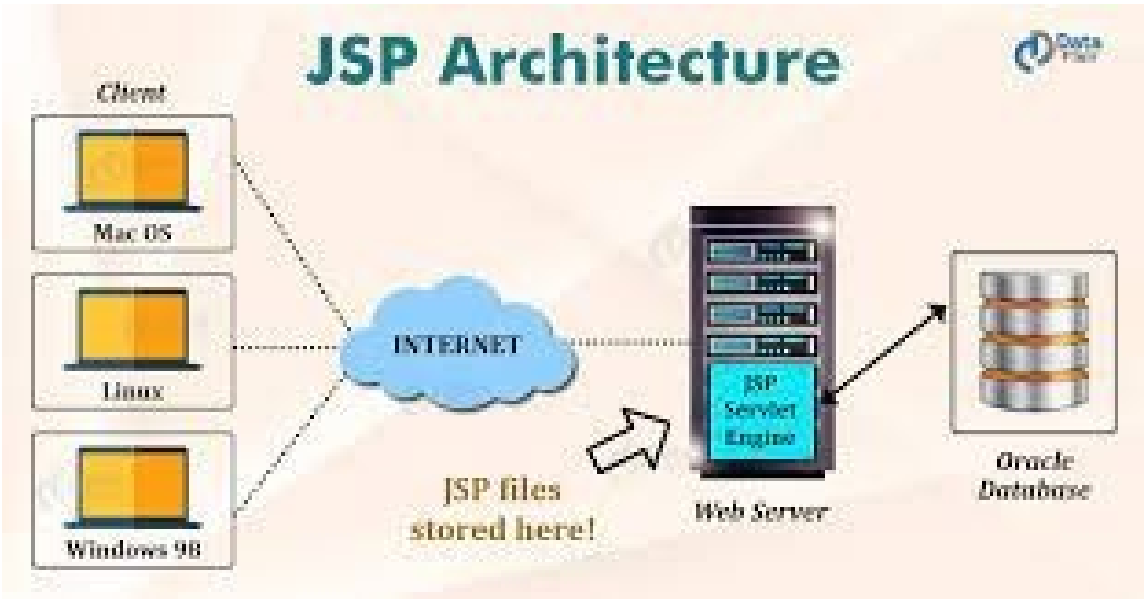
10. Mobile Compatibility: The dashboard should be mobile-friendly, allowing users to access volume data from their smartphones or tablets.

Overall, the functional requirements of a volume dashboard project should be designed to meet the needs of the business or organization, and provide users with timely and accurate insights into volume data.

6.Technology Stack

6.1. JSP:

JSP (JavaServer Pages) is a technology used for developing dynamic web applications in Java. It allows the creation of web pages that can contain dynamic content, such as database records, user input, or server-side logic. Eclipse is an integrated development environment (IDE) that supports JSP development.



6.2. Apache Tomcat

Tomcat server is a popular open-source web server and servlet container developed by the Apache Software Foundation. It is widely used for hosting Java web applications, including JSP pages and servlets.

- **Servlet Container**: Tomcat provides a servlet container that implements the Java Servlet and JavaServer Pages (JSP) specifications. This allows developers to create dynamic web applications using Java.
- **HTTP Server:** Tomcat is also a web server that can serve static web pages, handle
HTTP requests, and communicate with other servers and clients over HTTP.
- **Cross-Platform**: Tomcat is written in Java and can run on a variety of operating systems, including Windows, Linux, and macOS.
- **Lightweight**: Tomcat is designed to be lightweight and fast, with a small memory footprint and low CPU usage.
- **Easy Configuration**: Tomcat can be configured through XML files or a web-based
administration console. This makes it easy to customize its behavior and settings.

6.3. Db2 Database:

DB2 is a database product from IBM. It is a Relational Database Management System (RDBMS). DB2 is designed to store, analyze and retrieve the data efficiently. DB2 product is extended with the support of Object-Oriented features and non-relational structures with XML.
By Using Db2 database we can store the multiple clients data we can access, store, manage, retrieve the records.

6.4. Jasper Soft Reports

Jasper Reports is an open source Java reporting tool that can write to screen, to a printer or into PDF, HTML, Microsoft Excel, RTF, ODT, Comma-separated values and XML files.It can be used in Java-enabled applications, including Java EE or Web applications, to generate dynamic content. It reads its instructions from an XML or .jasper file.Jasper-Reports is an open source reporting library that can be embedded into any Java application

Multiple sources can be merged together.The data can be retrieved from defined data sources such as JDBC, CALS Table Models, JavaBeans, EJBQL, XML, Hibernate, and Comma-separated values, and additional data sources can be added to the **JasperReports** framework by plugging in a custom JRQueryExecuter. An extension is available to use Oracle PL/SQL stored procedures as a data source.

7.Non- Functional Requirements

Non-functional requirements are the attributes of a system that describe how well it operates, rather than what it does. Here are some examples of non-functional requirements that may be relevant for a volume dashboard project:

1. **Performance**: The dashboard should be able to handle large amounts of data and display it quickly, without any significant lag or delays.
2. **Availability**: The dashboard should be available for use at all times, with minimal downtime or maintenance required.
3. **Reliability**: The dashboard should be reliable and accurate, providing users with consistent and trustworthy data.
4. **Security**: The dashboard should be secure, protecting user data from unauthorized access or data breaches.
5. **Usability**: The dashboard should be easy to use, with an intuitive interface that allows users to quickly and easily access the data they need.
6. **Scalability**: The dashboard should be able to scale up or down to accommodate changes in data volume or user traffic, without affecting performance or reliability.
7. **Compatibility:** The dashboard should be compatible with a range of devices and platforms, allowing users to access the data from various locations and devices.
8. **Maintainability**: The dashboard should be easy to maintain and update, with a well documented codebase and clear instructions for any necessary changes.
9. **Interoperability:** The dashboard should be able to integrate with other systems and data sources, allowing for a seamless flow of data between different applications.

10. **Accessibility:** The dashboard should be designed to be accessible for all users, including those with disabilities, by complying with accessibility guidelines and
standards.

8.Software Requirements

Operating System : Windows 11
Web Server : Apache Tomcat
Database : Db2 Database

Client-side Requirements

Browser: Any HTML 4.0 or prior version compliance browser with a minimum screen resolution of 800X600 pixels (best viewed in 1024X768 resolution). JavaScript: It should be enabled in the browser

Hardware Requirements

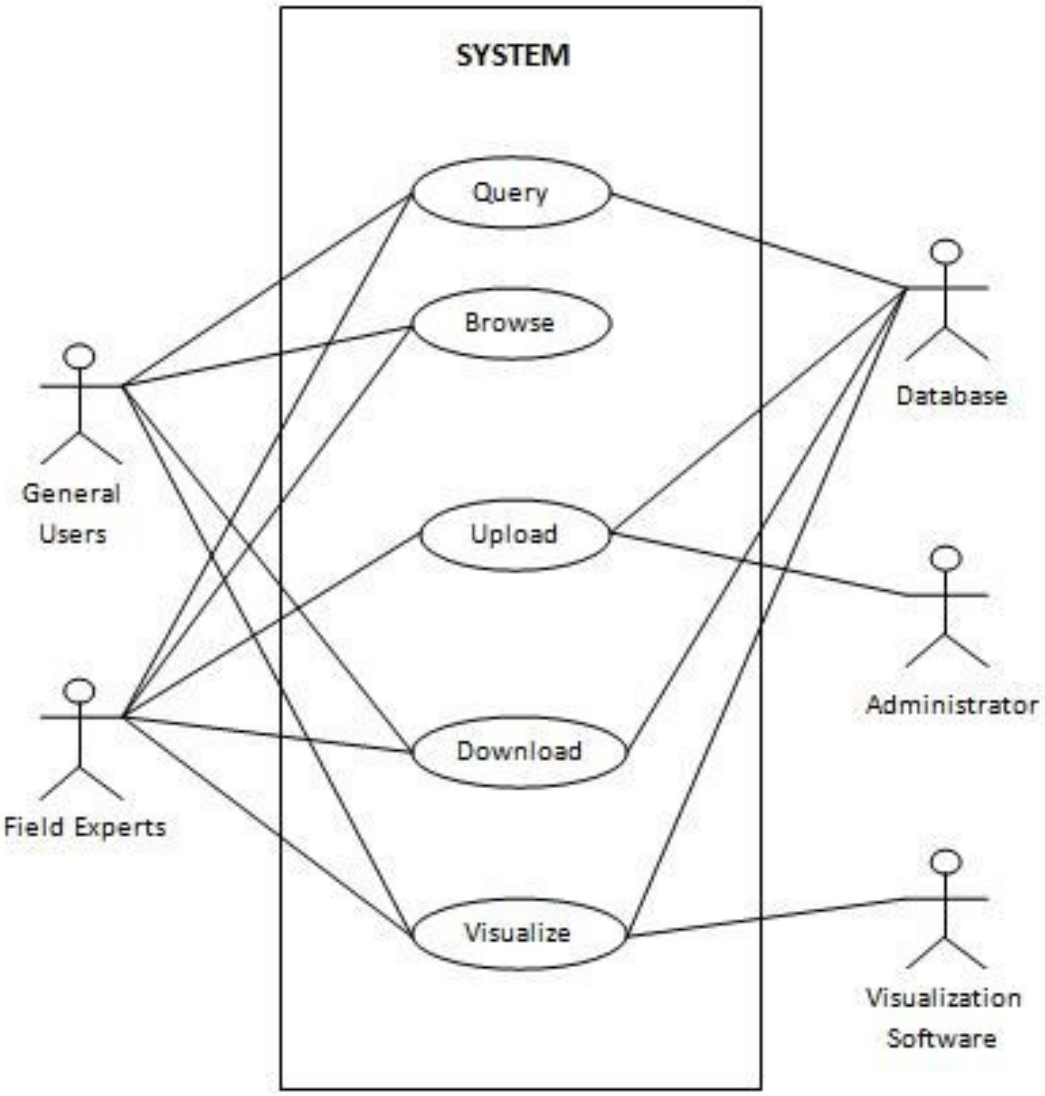
The following is a list of minimum requirements on server side.
Hard Disk: 40GB Hard disk with minimum 4GB free space
Interface: Mouse, Keyboard
On client side any hardware that can run a Web browser

Acceptance Criteria

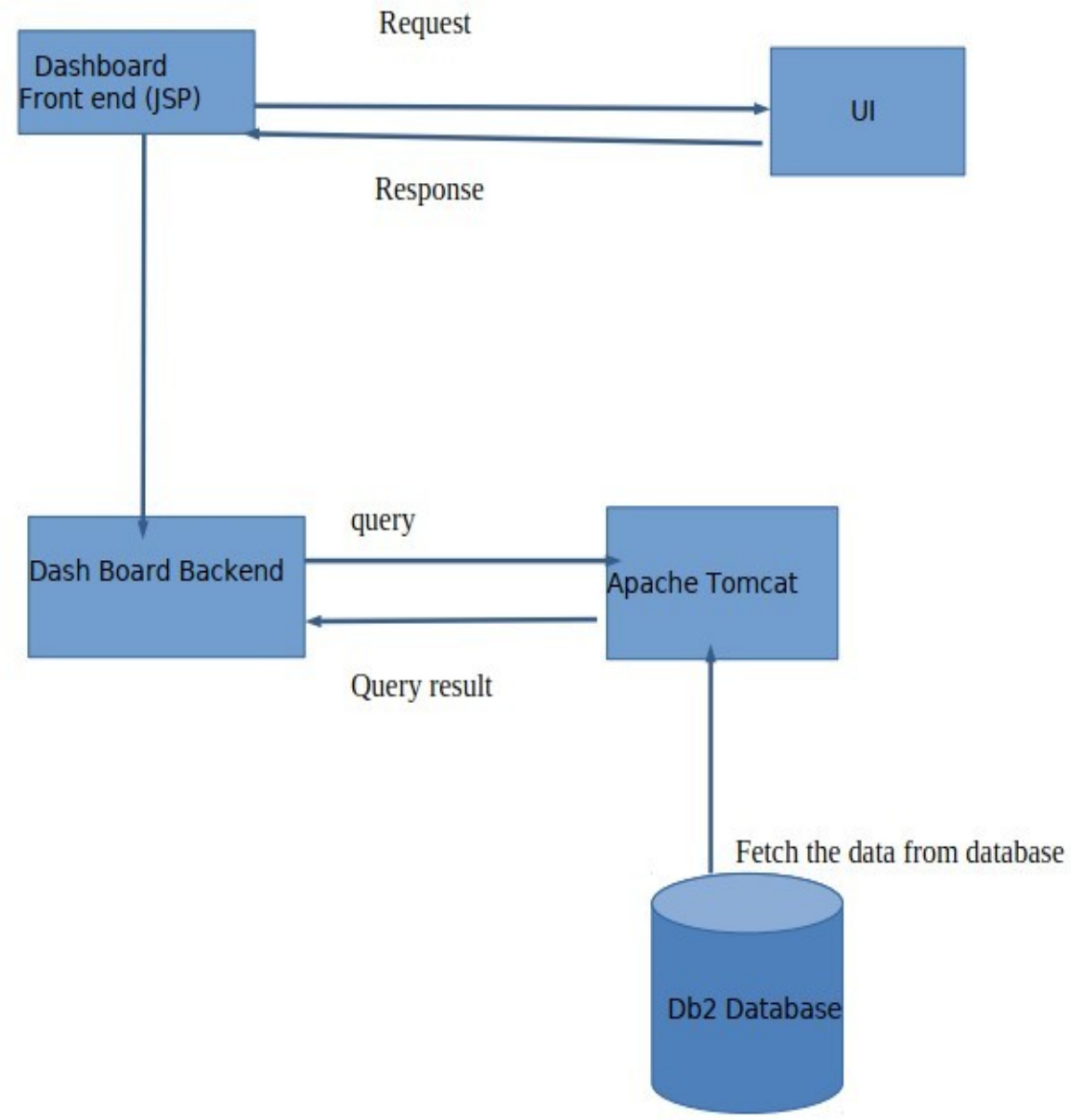
The dashboard shall be tested and validated to ensure that all functional and non-functional requirements are met. The portal shall be launched and made available to the public. The portal shall receive positive feedback from users, including high user engagement, user satisfaction, and successful report generation.

9.System Design

9.1 Use Case Diagram



9.2 Data Flow Diagram



10.Skills Learned

I had a good understanding of Business, Technology and Products, where they were very interactive during the sessions. On the business topics team gained a good understanding on US Bond Market, Mutual Funds, Equity Markets, Life cycle of a trade and etc.

In technology, team learned about writing and compiling program in basic Java syntax, using Java data types and incorporate branches and loops. Also few concepts such as encapsulation, abstraction, polymorphism and inheritance followed by introducing basic java concepts regarding classes, enabling us to start writing simple Java classes with attributes and methods and also introduced instances, or objects created from classes. This section also covered working with Strings, print output and use advanced math functions. Finally, this section covered namespaces and Java Libraries to explain how Java packages classes, so that everyone can develop code without name collisions and to be able to organize and access classes, as well as use selected standard classes from the Java runtime environment, And also gained good understanding of the Arrays, list, data structures etc

11. Contribution to the Project

I had gone through the below training concepts

1) Impact product overview and understood the process on the -batch remedies, Intraday issues what we get on day-to-day basis.
2) An overview of the remedy system and understood how the process works in tracking the remedy end to end.
3) AS/400 sessions to understand the concepts and performing hands on to be more
productive in product.
4) Understood the requirements of Volumes Database and learnt required technologies for developing Volumes Databases.
5) Analyzed how to collect data from different sources like Database, Spreadsheets and APIs.

12. Conclusion

The Volume Dashboard project is a powerful tool for monitoring and visualizing the flow of data through various systems in real-time. It provides real-time metrics and charts that help businesses to identify trends, performance issues, and potential bottlenecks. The project's architecture is designed to be scalable, secure, and highly available, with support for various data sources, processing techniques, and visualization tools. The project's functional and non-functional requirements have been carefully defined and implemented to ensure that it meets the needs of businesses of all sizes. Overall, the Volume Dashboard project is an effective solution for businesses looking to monitor and optimize the flow of data through their systems.

During the internship, Team had an overview about what Broadridge is and about its work culture and values i.e., honesty and integrity. Followed by the business trainings which has provided an understanding about the financial world, which includes core business concepts starting with financial markets and its participants, multiple asset classes, bond market, equity market, complete trade lifecycle that includes pre-trade, trade execution, trade clearing followed by settlement and post trade activities such as ongoing positions and risk management, derivatives, options, futures and forwards, mutual funds, and business of wealth management.

The second part of training gave us an understanding of some technical courses, which included Java, Sql, Python, RPA, and Web Technologies. And finally at last, the training sessions were on the various Broadridge products such as IMPACT, FinPro, GLOSS, BPS, BPSA and GPTM

13. Future Scope

The Volume Dashboard project has a wide range of potential future scope and can be further developed to provide even more advanced features and functionalities. Here are some potential future scopes for the Volume Dashboard project:

1. Predictive Analytics: The project can be extended to include predictive analytics features that use machine learning algorithms to predict future trends and patterns based on historical data.
2. Advanced Visualization: The project can be enhanced with advanced visualization tools, such as augmented reality and virtual reality, to provide an immersive and interactive experience for users.
3. Real-time Alerts: The project can be extended to provide real-time alerts and notifications to users when certain metrics exceed predefined thresholds, helping businesses to proactively identify and address issues.
4. Integration with Cloud Services: The project can be integrated with cloud services, such as Amazon Web Services (AWS) or Microsoft Azure, to provide a more scalable and cost-effective solution for businesses.
5. Mobile App: The project can be extended with a mobile app that provides real-time access to the dashboard from anywhere, allowing users to monitor the flow of data even when they are on the go.

14. References

1. https://www.broadridge.com/financial-services/capital-markets/transform-trade-lifecy-cle/equity-trade-processing
2. https://www.javatpoint.com/jsp-tutorial
3. https://tomcat.apache.org/
4. https://www.ibm.com/products/db2/database