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An Undergraduate Internship on Power BI (DATA ANALYST)

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Independent University, Bangladesh

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By

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Summer, 2023

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Dissertation submitted in partial fulfillment for the degree of
Bachelor of Science in Computer Science

Department of Computer Science & Engineering

Independent University, Bangladesh

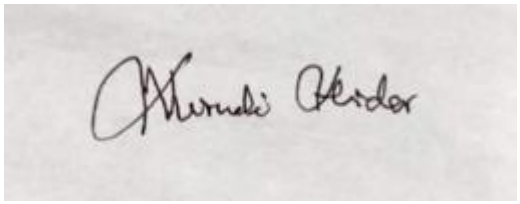
Attestation

This report, "Industrial Dashboard with Power BI," has been completed and presented in partial fulfillment of the requirements for the Degree in Computer Science and Engineering from Independent University, Bangladesh (IUB). I, Syed Ali Redwanul Haider (ID: 1930580), hereby certify.

I want to express my gratitude to Ms. Marzan Binte Hassan, my supervisor, for all of her guidance and assistance during my internship. His insightful opinions and vast experience have greatly aided in the project's success.

Furthermore, I certify that every piece of work in my report is original and reflects the knowledge and skills I have acquired throughout the internship. All of the information sources used for this research have been appropriately acknowledged and referenced.

Please send an email to Dodul Haque Khan, my internship supervisor at AND-Diginet, if you would like further details or clarification on this project.



10/19/2023

Signature Date:

Syed Ali Redwanul Haider

Name

Acknowledgement

I want to sincerely thank the Almighty for giving me the chance to finish my internship successfully. My sincere gratitude goes out to my family, friends, and seniors who supported and encouraged me no matter what during my internship and academic career. Their devotion to me and belief in me has always inspired me.

In addition, I would like to thank the professionals and authorities in the fields of computer science and software development who so kindly contributed their resources and knowledge via online communities and scholarly publications. Their assistance greatly improved my knowledge and abilities.

My supervisor, Ms. Marzan Binte Hassan, Adjunct Lecturer in the Department of Computer Science & Engineering at Independent University, Bangladesh, deserves a lot of appreciation from me. His advice and assistance were really helpful to me as I prepared for my report and during my internship. I owe Independent University, Bangladesh equal gratitude for giving me a thorough education in computer science and engineering that has paved the way for my future success in the workplace.

I would want to express my gratitude to Dodul Haque Khan, my industrial supervisor at ADN diginet, for all of his help, support, and advice throughout my internship. I was motivated to go above and beyond my own expectations by his inspirational remarks and guidance.

I sincerely appreciate all of the help and advice I had while working on my dissertation and internship. I have no doubt that this experience will be very beneficial to my future computer science aspirations. I sincerely thank everyone who has contributed to my path.

Letter of Transmittal

[24.09.23]

Ms. Marzan Binte Hassan
Adjunct Lecturer
Department of Computer Science & Engineering
Independent University, Bangladesh
Subject: Submission of Internship Report for Graduation Completion

Dear Sir,
I'm writing this letter to submit my internship report for the Computer Science and Engineering Bachelor's Program. It has been an honor to have your supervision and advice during my internship. The three months I had the honor of working as an intern at "AND Diginet," where I was supervised by Muhammad Dodul Haque Khan, are detailed in this report.

I immersed myself in the corporate atmosphere and got valuable intellectual and practical exposure throughout my internship. I have worked very hard to make sure my report is thorough and educational, utilizing the skills and knowledge I gained from my internship. I have followed the instructions to the letter, including thorough details in all sections that are necessary.

I genuinely hope that my report fulfills the standards of the internship program. I would be very grateful if you could accept this report and provide your insightful evaluation. It would be an enormous honor if you found this study to be informative and insightful, giving you a firm grasp of the subjects covered.

I would want to convey my appreciation for your steadfast support and direction during my internship. I am appreciative of the chance you have given me to grow and learn. I look forward to hearing from you regarding the report.

Yours sincerely,
Syed Ali Redwanul Haider
ID: 1930580
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Evaluation Committee

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Academic Supervisor Name: Marzan Binte Hasan	Industry Supervisor Name: Dodul Haque Khan

Panel Members

Panel Member-1 Name: Sanzar Adnan Alam	Panel Member-2 Name: Mohammad Motiur Rahman

Panel Members

Panel Member-3 Name: Md. Mahmudul Peyal	Panel Member-4 Name: Mahir Al Kamal

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Program Coordinator Name: Subrata Kumar Dey	Head of Department Computer Science & Engineering Name: Mahady Hasan

Abstract

In today's dynamic industrial landscape, data-driven decision-making stands as a foundational pillar of operational success. This document encapsulates the meticulous planning, development, and continual maintenance of an industrial dashboard designed to empower organizations in the monitoring, analysis, and optimization of their operational processes. With a focus on user-centric design, interactive functionality, robust data integration, and stringent security measures, the dashboard serves as a user-friendly and secure platform for informed decision-making. Notably, the integration of machine learning brings predictive maintenance, real-time anomaly detection, and data-driven insights to the forefront, transforming operational efficiency and risk mitigation. Furthermore, the project champions sustainability, environmental responsibility, and positive social impact, underpinned by a commitment to reducing ecological footprints and nurturing community relations. Looking ahead, the project envisions expanding data sources, enhancing user experiences, and maintaining an unwavering dedication to sustainability, making it a testament to the organization's commitment to data-driven excellence, responsible corporate citizenship, and a sustainable future.

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Chapter 1- Introduction

1.1 Overview/Background of the Work

Internships offer students invaluable real-world exposure, enabling them to delve into their professional interests and unlock their potential. These programs enable students to bridge the gap between their academic knowledge and practical application in real-world scenarios, helping them elevate their existing skills.
Independent University, Bangladesh incorporates internships as an integral component of its "Computer Science and Engineering" curriculum, forming a mandatory part of the graduation requirements. As an undergraduate student, I embarked on a three-month internship journey with "ADN digninet," a renowned corporation.
This report delves into my internship stint at "ADN digninet," providing an overview of the tasks I completed, the insights I gained, and the impact it had on my professional growth.

1.2 Objectives

During my internship, which commenced on May 4, 2023, at ADN Diginet, I had the privilege of contributing to several projects, one of which was the development of an Industrial Dashboard utilizing Power BI. The primary aim of this application was to modernize the process of data analysis within the industrial sector and provide valuable insights.

The core objective of this project is to design and implement an Industrial Dashboard using Power BI, with an added layer of machine learning integration. This initiative is driven by the growing need for industries to leverage data for informed decision-making and operational optimization. Through the creation of a dynamic and user-centric dashboard, our goal is to empower organizations to access real-time insights into their industrial operations, thereby facilitating data-driven decision-making to enhance efficiency, productivity, and competitiveness.

Another significant objective is to harness the potential of machine learning in industrial data analytics. By incorporating machine learning models into our dashboard, we aim to facilitate predictive maintenance, real-time anomaly detection, and data-driven insights. This objective aligns with the evolving landscape of industrial automation, where predictive analytics and proactive maintenance are crucial for minimizing downtime and ensuring machinery reliability.

Sustainability, encompassing responsible corporate practices and environmental impact, is at the core of this project. We aspire not only to deliver valuable data-driven solutions but to do so in an environmentally responsible manner. This project is committed to promoting ethical data practices, responsible resource management, and sustainability

initiatives. By achieving these objectives, we seek to set a precedent for the harmonious coexistence of data-driven excellence, ethical considerations, and a commitment to a greener future.

In summary, my project revolved around the development of an Industrial Dashboard for ADN Diginet, a dynamic software firm. Leveraging the capabilities of Power BI, our goal was to create a user-friendly, feature-rich online platform tailored to ADN Diginet's unique services and brand identity. The project aimed to offer customers a secure and user-friendly experience while providing effective administrative tools for the ADN Diginet team through seamless integration, data analytics, and robust content management systems.

1.3 Scopes

- **Data-Driven Decision-Making:** The project aims to empower organizations in the monitoring, analysis, and optimization of their operational processes through the Industrial Dashboard. It focuses on user-centric design, interactive functionality, robust data integration, and stringent security measures to enable data-driven decision-making.

- **Machine Learning Integration:** The project includes the integration of machine learning techniques to bring predictive maintenance, real-time anomaly detection, and data-driven insights to the forefront. This enhances operational efficiency and risk mitigation.

- **Sustainability and Ethical Considerations:** The project prioritizes ethical data practices, including privacy and bias mitigation. It also incorporates sustainability initiatives such as responsible resource management and reducing environmental impact, aligning with ethical and ecological responsibilities.

- **User Experience Enhancement:** The project focuses on enhancing user experiences by designing an intuitive and interactive user interface for the Industrial Dashboard. It aims to make data exploration and analysis accessible to users of varying technical backgrounds.

- **Scalability and Future-Readiness:** The project considers scalability to accommodate growing data volumes and computational demands. It also emphasizes future-readiness to adapt to evolving industrial landscapes and technological advancements.

- **Knowledge Transfer and Collaboration:** The project fosters interdisciplinary collaboration, encouraging knowledge sharing and innovation among team members. It aims to create a culture of learning and problem-solving.

Chapter 2 - Literature Review

2.1 Relationship with Undergraduate Studies

The knowledge and skills acquired during my undergraduate studies at IUB have played a crucial role in the development of the Industrial Dashboard With PowerBI. Without the foundation provided by these courses, undertaking this project would have been considerably more challenging. Some of the key courses that have been particularly beneficial include:

- CSE213 (Object-Oriented Programming in Java): This course delved into the fundamentals of object-oriented programming (OOP) concepts using Java. This knowledge has been directly transferable to the project, as I am using PHP, another object-oriented programming language.

- CSE309 (Web Application): While the web application course introduced me to various coding languages, it served as a valuable learning experience. It is directly applicable to my internship project; it marked the initial phase of my journey into web development.

- CSE307 (System Analysis and Design): This course covered requirement analysis and diagram drawing techniques. These skills were indispensable in understanding client requirements and subsequently designing the program accordingly.

- CSE303 (Database Management): Understanding fundamental ideas like entity-relationship (ER) diagrams and database architecture was made possible through a database management course. I used SQL Server Management Studio to build the project's database in my project.

- CSE203 & 211 (Data Structures and Algorithms): These courses deepened my understanding of data structures and algorithms, facilitating the adaptation to the architectural nuances of a new programming language.

- MIS341(Computers In Business): This course covered the PowerBI requirements and the knowledge of using the software for any analysis for a Data Analyst.

2.2 Related works

In the realm of industrial dashboards and data visualization, several noteworthy works and solutions have contributed to shaping the landscape. Notable examples include pioneering dashboard platforms like Tableau and Microsoft Power BI, which have become ubiquitous in various industries for their user-friendly interfaces and robust data integration capabilities. These platforms have set a precedent for efficient data visualization and analysis, offering organizations valuable tools for decision-making.

Additionally, the application of machine learning in industrial settings has gained substantial traction. Works such as predictive maintenance models using sensor data and anomaly detection algorithms have demonstrated the potential for machine learning to enhance operational efficiency and reduce downtime in industrial processes. Research on integrating machine learning techniques into dashboards to provide real-time insights and predictive analytics has showcased the transformative power of this combination.

Furthermore, the significance of sustainability and ethical considerations in industrial projects has been a recurring theme. Studies on sustainable manufacturing practices, environmentally

responsible data management, and ethical data usage have underscored the importance of aligning technological advancements with responsible and sustainable practices.
While these related works provide valuable insights and solutions in their respective domains, this project aims to amalgamate these concepts by creating an industrial dashboard empowered by Power BI and enriched with machine learning capabilities, while also placing a strong emphasis on ethical and sustainable data practices. This holistic approach aims to contribute to the ongoing evolution of industrial data management and decision support systems.

Chapter 3 - Project Management & Financing

3.1 Work Breakdown Structure

A graphical depiction of the project tasks and their connections is called a work breakdown schedule (WBS), and it offers a systematic description of project operations. Its goal is to assist project managers in organizing and managing a project by classifying it and dividing it into manageable components. You can efficiently distribute resources, assign tasks, and keep track of project progress by using a WBS. A WBS may be comprehensive when used in conjunction with a Gantt chart, guaranteeing clearly defined activities and promoting teamwork. In essence, the WBS acts as a crucial tool in project management, making it easier to plan, carry out, and manage projects.

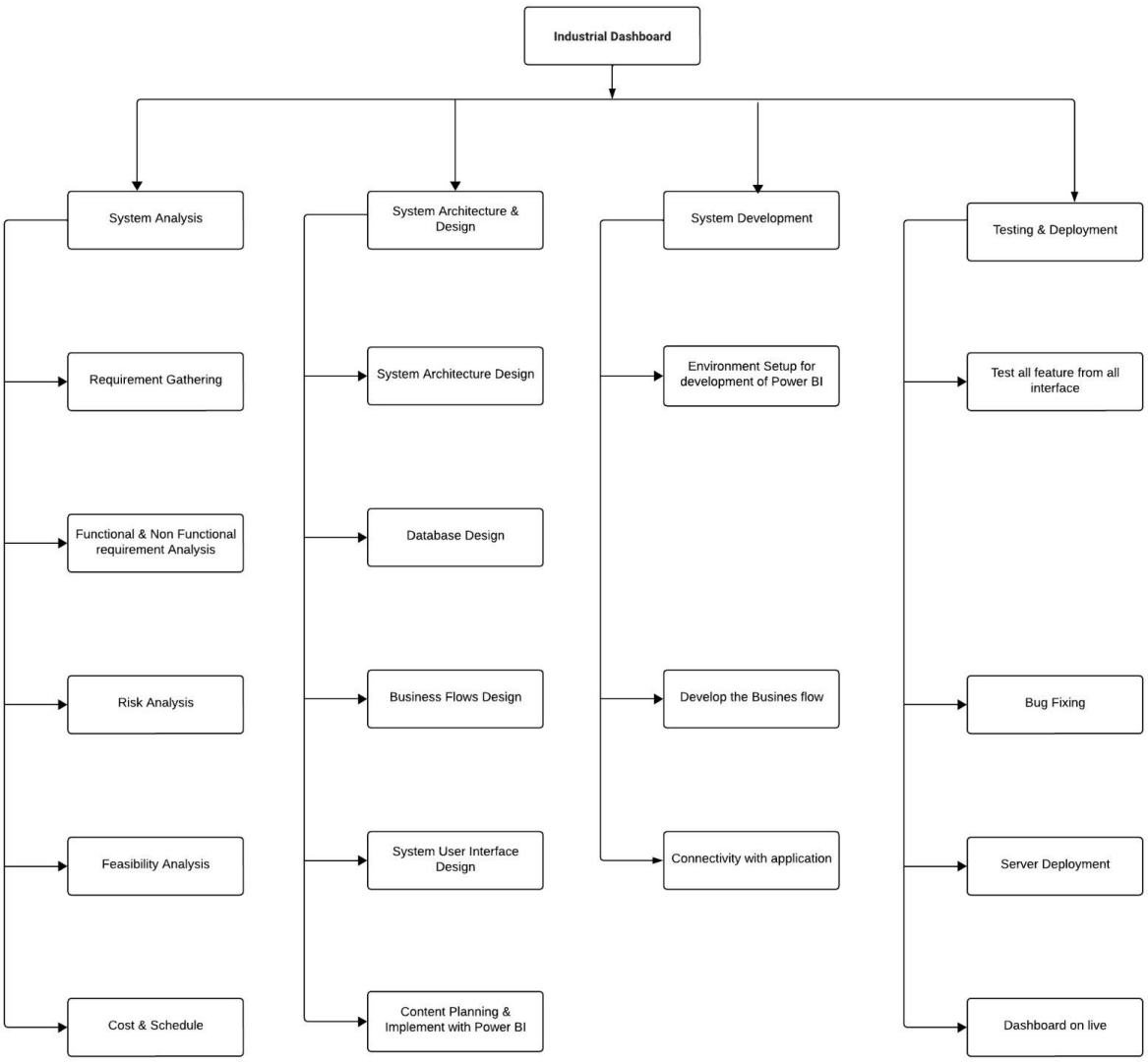

Fig 3.1 Work Breakdown Structure Diagram.

3.2 Process/Activity wise Time Distribution

The process/activity-wise time distribution has a significant impact on the anticipated amount of time required to properly execute the project. To guarantee that the project is completed on schedule, identifying the critical route is required. The longest sequence of tasks that must be completed on time is known as the critical route. On a critical path, each task is dependent on the outcome of the one that comes before it. The project itself is made up of a series of clearly defined tasks that must be carried out in a certain order in order to achieve the intended result. Project managers may ensure that milestones are accomplished within the allotted time frame by allocating resources to a project based on an analysis of the critical path and a comprehension of the temporal connections between activities.

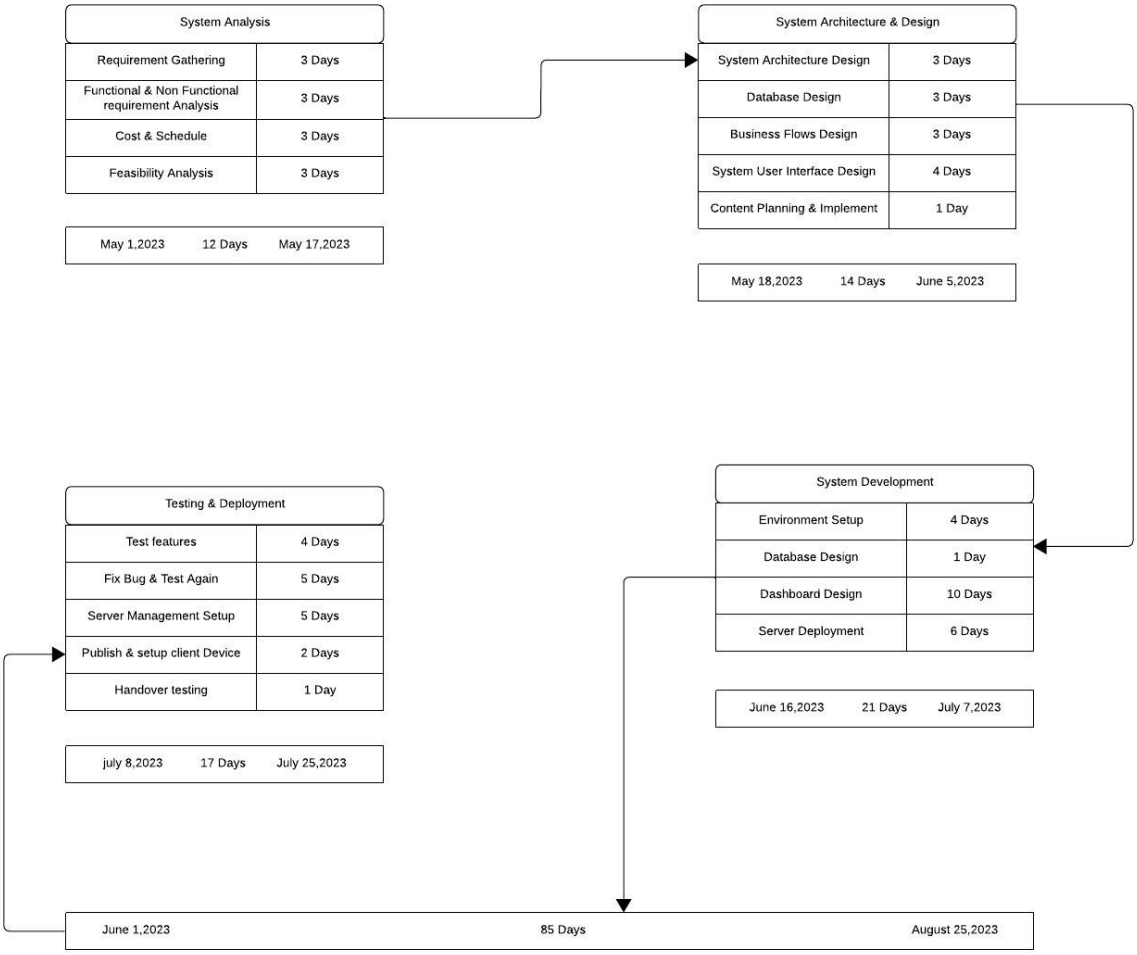

Fig 3.2 Process/Activity wise Time Distribution Diagram

3.3 Gantt Chart

During the application project's planning stage, a Gantt chart was used. To track and visualize project timelines, Gantt charts are frequently used in project management. They offer insightful information on task dependencies, development, priorities, and resource allocation. Gantt charts provide a clear picture of tasks and their associated timelines using a bar chart format. The key resource for this project was determined to be the developers, with office PCs and servers being necessary for implementation. Each employee was given particular assignments with due dates, and they all worked together to finish the project. The project's exact steps are described in the section that follows. Unfortunately, the company's guidelines prevented the creation of the Gantt chart.

3.4 Process/Activity wise Resource Allocation

Resource allocation for the Industrial Dashboard based on processes and activities A Power BI project necessitates a careful allocation of financial, technological, and human resources among several project stages and activities.. In the initiation and requirements gathering phase, skilled data analysts and domain experts are allocated to understand user needs and data sources. During the design and architecture phase, UI/UX designers and database architects play a crucial role in crafting the visual and structural elements of the dashboard. The development phase requires data engineers, machine learning specialists, and Power BI developers to build and integrate the technical components effectively. In the testing phase, quality assurance teams ensure the reliability and accuracy of the dashboard. Deployment involves IT administrators, and ongoing maintenance relies on a dedicated support team. Financial resources are allocated to procure necessary tools, licenses, and infrastructure, while human resources are optimized to ensure efficiency and quality throughout the project's lifecycle. This resource allocation strategy ensures a smooth and well-managed project execution.

3.5 Estimated Costing

The estimated costing for the Industrial Dashboard Project using Power BI encompasses various aspects, including personnel, software, hardware, and operational expenses.
Firstly, personnel costs are a significant component, considering the diverse team required for project development. This includes data analysts, machine learning specialists, UI/UX designers, database architects, Power BI developers, quality assurance engineers, and IT administrators. Salaries, training, and benefits for these professionals constitute a substantial portion of the budget.
Secondly, software costs encompass licensing fees for Power BI and any other proprietary software required for data analysis and machine learning. Additionally, there may be costs associated with third-party plugins or tools used for specific functionalities within the dashboard.
Hardware costs relate to the infrastructure required for hosting the dashboard, including servers, storage solutions, and networking equipment. The scalability of hardware resources should be considered to accommodate potential future growth in data volume and user traffic.

Operational expenses cover ongoing costs such as maintenance, updates, and technical support. These expenses ensure the dashboard remains operational, secure, and up-to-date with the latest data sources and machine learning models.

It's important to note that cost estimation should also account for unforeseen contingencies and potential scope changes. Proper financial planning and monitoring are essential to ensure that the project remains within budget while delivering the desired features and functionalities.

Chapter 4 - Methodology

- **Lectures and Training Sessions:** The project commenced with an extensive series of lectures and training sessions tailored to the specific needs of industrial data analysis using Power BI. These sessions covered a wide range of topics, including data visualization techniques, Power BI functionalities, data preprocessing, machine learning fundamentals, and advanced programming in Python. These foundational skills were essential to equip the team with the necessary expertise to tackle the complexities of industrial data analysis and visualization.

- **Research and Review:** A significant portion of the project's early stages was dedicated to in-depth research and literature reviews. The objective was to gain a profound understanding of industrial dashboard design, best practices in data integration, and the application of machine learning in the industrial context. The team meticulously reviewed academic papers, industry reports, and case studies to identify trends, challenges, and innovative solutions relevant to the project's goals.

- **Seminars and Consultations:** To ensure alignment with industry requirements and to gather insights from experts in the field, the team organized regular seminars and consultations. These sessions involved interactions with industrial professionals, data analysts, and domain experts who provided valuable guidance and feedback throughout the project's development. These consultations played a crucial role in refining the project's scope and ensuring it met the specific needs of industrial stakeholders.

- **Problem Identification:** A critical phase of the project involved the identification of key challenges in industrial data analysis. The team conducted extensive interviews with industry professionals, studied historical data, and analyzed operational processes to pinpoint areas where the proposed industrial dashboard could provide the most significant value. This phase helped shape the project's objectives and prioritize features that addressed real-world industrial data analysis challenges.

- **Solution Development:** With a clear understanding of the challenges and requirements, the project entered the solution development phase. This involved the iterative design of the industrial dashboard's architecture, which included data integration pipelines, real-time data feeds, and machine learning model integration. The development team simultaneously worked on building machine learning models for predictive maintenance, anomaly detection, and trend analysis. The seamless integration of these models with Power BI was a central focus, ensuring that data-driven insights were readily available within the dashboard.

- **Lessons Learned:** Throughout the project, the team accumulated a wealth of knowledge and experiences. These lessons encompassed not only technical aspects but also personal and professional growth. Key takeaways included a comprehensive understanding of machine learning, proficiency in developing and deploying machine learning models, insights derived from extensive literature reviews, practical application through case studies, the opportunity to learn from industry specialists, honing the skills of problem identification and solution development, conducting rigorous evaluations, iterative improvement of solutions, understanding the practical

implications of data-driven decisions in an industrial setting, fostering personal growth, and maintaining a forward-looking perspective to address future challenges in industrial data analysis. These lessons not only enriched the team's capabilities but also contributed to the long-term sustainability and impact of the project within the industrial context.

Chapter 5 - Body of the Project

The information regarding the project is contained in the chapter's body. Here, the reader will discover comprehensive project information. A detailed job description, an analysis of the project's requirements, a system analysis, a system design, development, and testing are just a few of the documents that will be included to this chapter.

5.1 Work Description

The work description for the project, which focuses on the development of an Industrial Dashboard using Power BI, encompasses a multifaceted approach tailored to the unique requirements of industrial data analysis and visualization. The project's primary objective is to modernize the data analysis process within industries, enabling organizations to gain real-time insights into their operational processes. This involves several key tasks, including data collection from various sources such as sensors and databases, data preprocessing to ensure quality and consistency, and the development of machine learning models for predictive maintenance and anomaly detection. These steps are critical for creating a powerful and dynamic Industrial Dashboard that empowers organizations to make data-driven decisions for enhanced efficiency and competitiveness.

Additionally, the project places a strong emphasis on sustainability, both in terms of responsible corporate citizenship and environmental impact. It aims to foster a culture of ethical data practices, responsible resource management, and sustainability initiatives. This includes addressing ethical considerations such as data privacy and security, ensuring that sensitive information is safeguarded, and compliance with relevant regulations. Furthermore, the project aligns with the ever-evolving landscape of industrial automation by infusing machine learning capabilities into the dashboard, allowing for proactive maintenance and reliability enhancement, which are crucial for minimizing downtime and ensuring the smooth operation of critical machinery.

Throughout the project's lifecycle, effective project management practices are employed, encompassing task scheduling, resource allocation, milestone tracking, and risk management to ensure that the project remains on schedule and within budget. The project also includes rigorous testing and quality assurance processes to guarantee the reliability and accuracy of both data integration and machine learning components. Knowledge transfer sessions are conducted to empower team members and stakeholders with a deep understanding of the project's components, enabling them to independently manage and expand the dashboard's capabilities. Overall, the work description underscores the project's commitment to delivering a comprehensive and sustainable Industrial Dashboard solution that not only enhances user experiences but also aligns with ethical considerations and a commitment to a greener future.

5.2 Requirement Analysis

5.2.1 Rich Picture

Building a preliminary mental model of a situation can be accomplished through exploring, acknowledging, and identifying it, as well as by visually portraying it using a Rich Picture. A thorough explanation makes it easier to have a conversation and results in a shared body of knowledge between all parties.. The detailed image displays the activity of the three different system users—in-service providers and customers—as a whole. The system, including user accounts, service categories, and provider profiles, is managed by the admin. The individual performing various tasks, such as receiving service requests, updating availability, and completing service orders, is shown as the service provider.. The client is represented as someone who makes money, requests services, and offers comments. And with the image of the database from SQL Server Management studio added, displaying the underlying database that is utilized to administer and store system data.

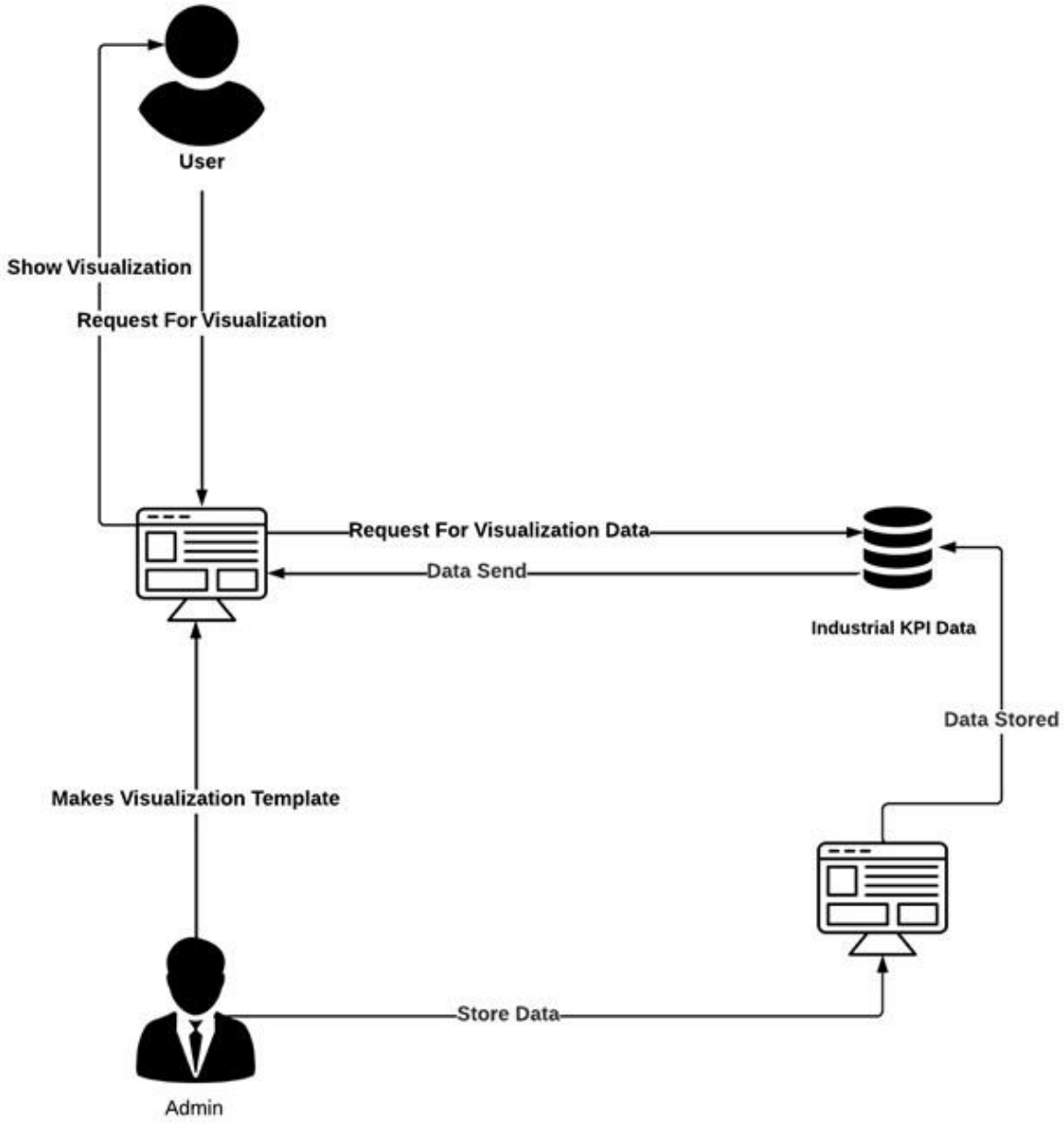

Fig 5.2 Rich Picture

5.2.2 Functional

Functional requirements fundamentally outline what a system should be able to achieve.

1. Data Ingestion and Integration:

The dashboard should have the capability to ingest data from various sources, including databases, spreadsheets, APIs, and real-time streams. It should support data integration processes to combine, cleanse, and transform data into a unified format suitable for analysis.

2. Interactive Visualization:

The dashboard must enable users to create interactive visualizations using Power BI, allowing for the exploration of data through charts, graphs, tables, and maps. Users should have the ability to customize and personalize their dashboards, including selecting data attributes, applying filters, and configuring visualization settings.

3. Machine Learning Integration:

The integration of machine learning models should be seamless, allowing administrators to incorporate predictive and analytical models into the dashboard. Users should be able to leverage ML insights for tasks such as anomaly detection, predictive maintenance, and forecasting directly within the dashboard.

4. Real-Time Data Updates:

The dashboard should support real-time or near-real-time data updates, ensuring that users have access to the latest information and insights. It should enable data streaming and automatic refreshes to maintain data currency.

5. Collaborative Features:

Collaboration features, such as commenting, sharing, and annotation, should be available to facilitate teamwork and discussions among users. Users should be able to share specific visualizations or insights with colleagues for collaborative decision-making.

6. Security and Access Control:

Robust security measures should be in place to protect sensitive data and ensure that access is granted only to authorized users. Administrators should have the ability to define user roles, permissions, and data access levels.

7. Export and Reporting:

Users should be able to export data, visualizations, and reports in various formats (e.g., PDF, Excel) for offline analysis and reporting purposes. Scheduled report generation and distribution should be supported.

8. Notification and Alerting:

The dashboard should provide notification and alerting mechanisms to notify users of

critical events, anomalies, or predefined thresholds. Users can set up alerts to proactively monitor changes in data patterns.

9. Documentation and Help Resources:

The dashboard should include comprehensive documentation and help resources to guide users in data analysis, visualization, and ML model utilization. Tutorials, tooltips, and FAQs should be available for user assistance.

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5.2.3 Non-Functional Requirements

A system's "quality attributes" are what they are termed. It is a requirement that defines criteria for judging the operation of a system.

1. Security:

a. The system should ensure data security and protect user information.

b. User authentication and authorization mechanisms should be in place.

2. Performance:

a. The system should be responsive and able to handle a reasonable number of concurrent users.

b. Recommendation algorithms should provide quick and relevant results.

3. Scalability:

a. The system should be designed to scale if the number of books and users grows.

b. It should accommodate an increasing volume of data.

4. Usability:

a. The user interface should be intuitive and user-friendly for both systems owners and readers.

b. Proper navigation and clear labeling should be implemented.

5. Reliability:

a. The system should be available and reliable, minimizing downtime.

b. Data backups and recovery mechanisms should be in place.

6. Data Integrity:

a. The system should maintain data integrity, preventing data corruption or loss.

b. Proper data validation and error handling should be implemented.

7. Compatibility:

a. The system should be compatible with common web browsers and devices used by system owners and readers.

b. Cross-browser and cross-device testing should be conducted.

8. Response time:

a. The system should provide quick responses to user actions, such as adding items to the cart or submitting ratings.

b. Response time should meet acceptable thresholds.

9. Privacy:

a. The system should respect user privacy and adhere to data protection regulations.

b. User data should be handled security and in compliance with privacy laws.

5.3 System Analysis

5.3.1 Six Element Analysis

Process	System Roles					
	Human	Non-Computing Hardware	Computing Hardware	Software	Database	Networking & Communication
Visualize The Data	**End-Users**: The individuals or teams who will interact with and utilize the Industrial Dashboard to make data-driven decisions and optimize operational processes. **Administrators:** Those responsible for managing and maintaining the dashboard, including user access control, data updates, and system configuration.	**Book:** The book whose data will be added. **Paper:** Book details might come printed ona sheet ofpaper.	**Server Infrastructure:** The physical servers and hardware components that host the Power BI environment, ensuring robust performance, scalability, and reliability. **Client Devices:** The devices (e.g., desktop computers, mobile devices) used by end-users to access and interact with the Industrial	**Power BI:** The core software platform used for data analysis, visualization, and creating interactive dashboards. **Machine Learning Models:** Software components that incorporate machine learning algorithms to provide future insights and predictive capabilities within the dashboard.	**Data Sources:** The various data repositories and sources (e.g., databases, data warehouses) that supply raw data to the Industrial Dashboard for analysis and visualization. **Data Transformation Tools:** Software tools or processes responsible for extractin	**Network Infrastructure:** The underlying network architecture and components that enable seamless data transfer between the Industrial Dashboard, data sources, and end-users. **Data Communication Protocols:** The protocols and methods used for secure and efficient data communic

			Dashboard. **Printer:** It might be used to print out book details.		g, transforming, and loading (ETL) data from source systems to prepare it for analysis in Power BI.	ation between different components of the system, ensuring data integrity and confidentiality.
Admin makes the visualization	**Administrators:** In this context, administrators take on the role of creating and managing visualizations within the Industrial Dashboard. They are responsible for designing and configuring the dashboard to meet the specific needs of end-users	Book: The book whose data will be edited. Paper: Book details might come printed on a sheet of paper.	**Server Infrastructure:** The physical servers and hardware components that host the Power BI environment, providing the necessary computational	**Power BI**: The primary software tool used by administrators to create, customize, and configure visualizations within the Industrial Dashboard. Power BI offers a user-friendly interface for building data-driven visualizations.	**Data Sources:** The various data repositories and sources that provide raw data for visualization. Administrators access and integrate these data sources into Power BI to design visualizations based on relevant data.	**Network Infrastructure:** The network architecture and components that enable administrators to access data sources and the Power BI environment securely and efficiently. **Data Communication Protocols:** The protocols and methods

	and the organization.		resources for administrators to develop and maintain visualizations efficiently. **Client Devices:** The devices used by administrators to access the Power BI environment for visualization design and configuration.	**Data Visualization Tools:** Additional software tools or plugins that may be integrated with Power BI to enhance the visualization capabilities, allowing administrators to create more advanced and specialized visualizations if needed.		used for secure data transfer between administrators' client devices, data sources, and the Power BI environment, ensuring that data is transmitted and processed accurately.
Data Integration By Administration	**Administrators:** Administrators play a crucial role in data integration as they are responsible for orchestrating the process of collecting, transforming, and integrating data from various sources into the Industrial Dashboard. They ensure	**Book:** The book whose data will be edited. **Paper:** Book details might come printed ona sheet of paper.	**Server Infrastructure:** The server infrastructure hosts the data integration tools and processes used by administrators to collect, process, and store data from diverse sources. It provides the computational resources needed for data integration tasks. **Client**	**Data Integration Tools:** Specialized software tools for data extraction, transformation, and loading (ETL) are utilized by administrators to integrate data from heterogeneous sources into a unified format suitable for visualization in Power BI. **Power BI:** Power BI serves as	**Data Sources:** Data sources encompass the diverse repositories and systems from which data is extracted and integrated. Administrators identify, access, and configure connections to these sources to	**Network Infrastructure:** Network infrastructure ensures secure and efficient communication between data sources, data integration tools, and the Power BI environment. Administrators rely on a robust network for data retrieval and integration

	that data is harmonized and structured for effective visualization.		**Devices:** Administrators use client devices to access data integration tools and the Power BI environment, where they configure data connections and transformation pipelines.	the visualization platform and also plays a role in data integration, allowing administrators to establish data connections, perform data modeling, and combine data from various sources.	acquire the required data for visualization.	. Data **Communication Protocols:** Data communication protocols facilitate the secure and reliable transfer of data between data sources, data integration tools, and the Industrial Dashboard, ensuring that data integration processes operate smoothly.

Table 5.1 Six Element Analysis

5.3.2 Feasibility Analysis

Technical Feasibility

- Technical feasibility is a pivotal aspect of our Industrial Dashboard project, which centers on data analysis and visualization through Power BI and the integration of machine learning for future insights. It involves a thorough evaluation of our existing technological infrastructure to ascertain its compatibility and adequacy for the successful implementation of our dashboard. This assessment encompasses hardware, software, and data integration capabilities. We need to ensure that our computing hardware, including servers and client devices, meets the prerequisites for running Power BI and machine learning tools seamlessly. Additionally, we must validate the compatibility of our software stack with the chosen hardware environment, ensuring that Power BI, machine learning frameworks, and data integration tools work harmoniously. Furthermore, technical feasibility encompasses the ability to integrate data from diverse sources efficiently, deploy machine learning models effectively, handle real-time data updates, scale our system, and maintain robust security measures. Ultimately, this assessment safeguards the technical viability of our project and ensures that our Industrial Dashboard can

deliver powerful data-driven insights while maintaining stability and security within our existing technological landscape.

Operational Feasibility

- Operational feasibility is a pivotal facet of our Industrial Dashboard project, where the focus lies on data analysis, visualization using Power BI, and the integration of machine learning models for predictive insights. Assessing the operational feasibility is essential to ensure that the project aligns seamlessly with our existing operational processes and can be effectively integrated into our day-to-day activities. A critical component of this assessment is user readiness and adoption. We need to ascertain whether our team members, including administrators and end-users, can readily adapt to the dashboard's interface and functionalities. This involves providing comprehensive user training and accessible documentation to empower individuals with the skills and knowledge needed to utilize the dashboard effectively.
- Furthermore, operational feasibility extends to the dashboard's impact on our operational efficiency. We must evaluate whether the dashboard enhances our decision-making processes, streamlines workflows, and ultimately contributes to increased efficiency and productivity within our organization. The dashboard should be assessed not only in terms of its technical capabilities but also in its ability to provide actionable insights that can be readily incorporated into our operational strategies. Aligning the project with our organizational goals and ensuring that it facilitates data-driven decision-making is a primary objective.
- Ultimately, operational feasibility serves as a critical checkpoint to ensure that our Industrial Dashboard seamlessly integrates into our operations, enhances our ability to derive meaningful insights from data, and empowers us to make informed, data-driven decisions efficiently. By evaluating and addressing operational considerations, we aim to maximize the value and impact of the dashboard within our organization, fostering a culture of data-driven excellence.

Financial Feasibility

- Financial feasibility is a pivotal aspect of our Industrial Dashboard project, which revolves around data analysis, visualization using Power BI, and the integration of machine learning models. It is imperative to conduct a thorough financial assessment to ensure the project's sustainability and fiscal responsibility.
- First and foremost, cost analysis is a fundamental component of financial feasibility. We need to meticulously calculate all associated costs, encompassing both initial and ongoing expenditures. These include hardware procurement, software licensing fees for Power BI and machine learning tools, infrastructure maintenance, personnel costs for training, development, and support, as well as any unforeseen contingencies. By quantifying these expenses, we gain a comprehensive understanding of the financial commitment required for the project's successful execution.
- In parallel, evaluating the return on investment (ROI) is paramount. We must assess how the project's anticipated benefits align with the costs incurred. These benefits encompass improved decision-making capabilities, heightened operational efficiency, predictive insights, and enhanced data-driven decision-making. By quantifying the projected ROI, we can effectively justify the financial investment in the dashboard and ascertain its long-term value to the organization.

Schedule Feasibility

- Schedule feasibility holds significant importance in our Industrial Dashboard project, focusing on data analysis, Power BI visualization, and the integration of machine learning models. It entails a thorough evaluation of our project timeline to ensure it is both realistic and attainable. We start by defining clear milestones and deadlines for each project phase, ranging from data integration to dashboard development, machine learning model integration, rigorous testing, and final deployment. This structured timeline serves as our roadmap, guiding the project's progression.

- Additionally, assessing resource availability is paramount to maintain schedule feasibility. We must ensure that skilled personnel, computing infrastructure, and data sources are accessible when needed. Early identification of potential resource constraints allows for proactive resource allocation, minimizing disruptions and schedule risks.

5.3.3 Problem Solution Analysis

Problem Solution Analysis involves a comprehensive assessment of the challenges and issues that the project aims to address, along with the strategies and solutions devised to mitigate or resolve these challenges. In the context of the Industrial Dashboard project using Power BI, the analysis centers on the specific problems faced by industrial organizations in monitoring and optimizing their operational processes. These problems typically include:

1. **Data Overload:** Industries often generate vast amounts of data from sensors, machines, and various sources. Managing and extracting meaningful insights from this data can be overwhelming, leading to information overload.

2. **Lack of Real-Time Visibility:** Many industrial processes require real-time monitoring to prevent issues and optimize performance. Traditional methods may not provide the necessary real-time visibility into critical processes.

3. **Predictive Maintenance:** The project aims to address the challenge of predictive maintenance. Machinery breakdowns can lead to costly downtime. By implementing machine learning models, the project seeks to predict when maintenance is required to avoid such breakdowns.

4. **Data Security and Privacy:** Industries handle sensitive data that must be protected from breaches and unauthorized access. Ensuring the security and privacy of this data is a paramount concern.

5. **Sustainability:** Industries are increasingly focused on sustainability and minimizing their environmental impact. The project aims to provide insights that can help organizations reduce resource consumption and operate in a more environmentally responsible manner.

To tackle these challenges, the project proposes several solutions:

1. **Data Integration:** The project integrates data from various sources into a unified Power BI dashboard, providing a centralized view of critical information.

2. **Real-Time Monitoring:** Power BI's capabilities enable real-time monitoring of industrial processes, allowing for immediate action in response to anomalies.

3. **Predictive Maintenance Models:** Machine learning algorithms are employed to develop predictive maintenance models that can forecast when equipment requires servicing.

4. **Data Encryption and Access Control:** Robust security measures are implemented to ensure data security and privacy, including encryption and strict access controls.

5. **Sustainability Analytics:** The project includes sustainability analytics to provide insights into resource usage and environmental impact, helping organizations make sustainable decisions.

5.3.4 Effect and Constraints Analysis

Effect and Constraints Analysis delves into the potential impacts and limitations of the Industrial Dashboard project using Power BI, providing a comprehensive understanding of its implications. In this analysis, we explore both the positive effects and the constraints that need to be considered:

Positive Effects:

- Improved Decision-Making: The implementation of the Industrial Dashboard empowers organizations with real-time data visualization and analytics. This leads to more informed decision-making, optimizing processes, and enhancing overall efficiency.

- Enhanced Productivity: By offering a centralized platform for data analysis and reporting, the project streamlines workflows and reduces the time spent on data gathering. This, in turn, enhances productivity across various industrial sectors.

- Cost Reduction: Predictive maintenance and real-time anomaly detection provided by machine learning models help in reducing downtime and maintenance costs. Organizations can address issues proactively, leading to significant cost savings.

- Environmental Impact: The inclusion of sustainability analytics promotes environmentally responsible practices. By analyzing resource consumption and emissions, organizations can identify areas for improvement and reduce their ecological footprint.

- Data Security: Robust data security measures ensure the confidentiality and integrity of sensitive industrial data, fostering trust among stakeholders.

Constraints:

- Resource Limitations: The project may require substantial resources, including hardware, software, and skilled personnel, which can be a constraint for smaller organizations with limited budgets.

- Integration Complexity: Integrating data from diverse sources can be complex, and ensuring compatibility with Power BI and machine learning models may require significant effort.

- Data Quality: The effectiveness of the dashboard and machine learning models relies on the quality of the data. Poor data quality can lead to inaccurate insights and decisions.

- Change Management: Implementing a new dashboard and data analytics approach may require a cultural shift within organizations. Resistance to change and the need for training can be challenges.

- Scalability: As organizations grow, the scalability of the system may become a constraint. Expanding the dashboard to handle larger datasets and more complex processes can be challenging.

5.4 System Design

5.4.1 UML Diagrams

UML diagrams are visual representations of many features of a system that are based on the Unified Modeling Language (UML). They offer a standard syntax for recording and conveying many parts of a software program, including as actors, roles, actions, classes, and artifacts. UML diagrams aid in the understanding, modification, maintenance, and documentation of system information. They allow software developers, designers, and stakeholders to visualize the structure, behavior, and interactions inside the system, making complex software systems easier to understand and convey.

Entity Relation Diagram for Industrial Dashboard

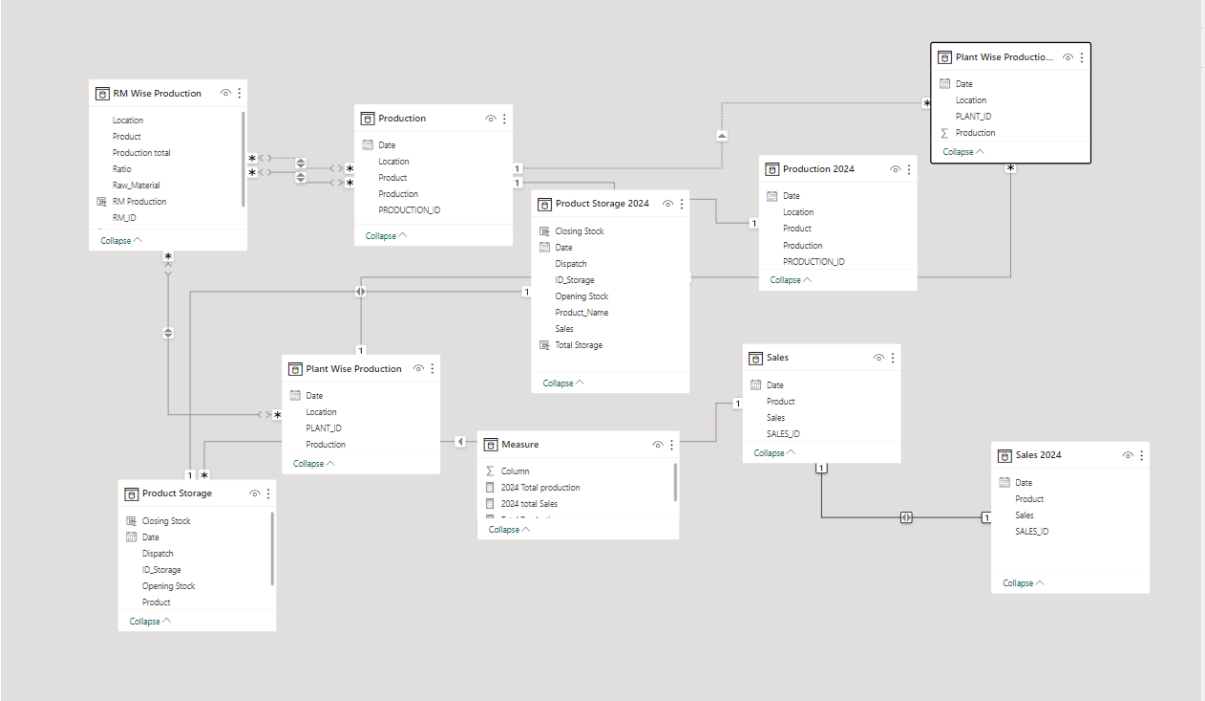

Fig 5.2 Entity Relation Diagram for Industrial Dashboard

5.5 Implementation

The Implementation phase of the Industrial Dashboard project using Power BI represents the turning point where the carefully planned strategies and designs come to life in a dynamic and interactive digital platform. At its core, this phase is all about

translating ideas and concepts into tangible solutions that empower organizations to harness the full potential of their industrial data.

Data integration serves as the foundation of this phase. It involves collecting, processing, and merging data from a multitude of sources, ranging from industrial sensors to databases. This meticulous data integration ensures that the Power BI dashboard receives a continuous stream of real-time data, which is vital for providing timely insights and supporting data-driven decision-making.

The heart of the implementation lies in dashboard design, where the visual representation of data takes shape. Designers and data visualization experts collaborate to create intuitive, informative, and visually appealing charts, graphs, and reports. The goal is to empower users, from operators to executives, with the ability to explore data effortlessly, identify patterns, and gain actionable insights.

Machine learning models are seamlessly integrated into the Power BI environment during this phase. These models are carefully configured to deliver predictive maintenance, real-time anomaly detection, and data-driven insights. Their integration brings a new dimension to industrial operations, enabling organizations to foresee issues before they occur and optimize processes for maximum efficiency.

Security is a paramount concern during implementation. Robust security measures, including access controls, encryption, and authentication, are meticulously implemented to safeguard sensitive industrial data. Regular security audits and monitoring are conducted to ensure data integrity and compliance with industry standards and regulations.

5.6 Testing

5.6.1 Input

During the testing phase of the Industrial Dashboard project using Power BI, a variety of input data is fed into the system. This input encompasses industrial data from sensors, databases, and other relevant sources. It includes real-time data streams, historical data sets, and simulated scenarios to evaluate the dashboard's performance under different conditions.

5.6.2 Output

The output in the testing phase involves examining the results generated by the Industrial Dashboard. This includes the visualizations, reports, and insights presented to users. Testers assess the accuracy, relevance, and responsiveness of these outputs to ensure that they meet the objectives of providing valuable insights for data-driven decision-making.

5.6.3 Designing Test Cases

To conduct thorough testing, a set of test cases is meticulously designed. These test cases encompass various scenarios, from routine data updates to exceptional situations like data spikes or system failures. Testers create test cases that mimic real-world industrial scenarios to validate the dashboard's performance, data accuracy, and machine learning model predictions.

5.6.4 Test Results

Test results are the outcome of executing the designed test cases. They provide insights into the functionality and reliability of the Industrial Dashboard. During this phase, any discrepancies, errors, or performance issues are identified, documented, and addressed. Test results serve as a critical feedback loop, enabling continuous improvement and refinement of the dashboard.

The testing phase is a crucial step in ensuring the robustness and effectiveness of the Industrial Dashboard. It verifies that the dashboard can handle diverse data inputs, produce meaningful outputs, and maintain its functionality under varying conditions. It is a pivotal stage in delivering a reliable and high-quality solution for data-driven decision-making in industrial settings.

Chapter 6 - Results & Analysis

In this section, we will examine the project/work findings and assess their implications. The outcomes are based on the design and implementation of the Industrial Dashboard system. Let us investigate the results and do a detailed analysis.

- **We have the Dashboard based on the database**

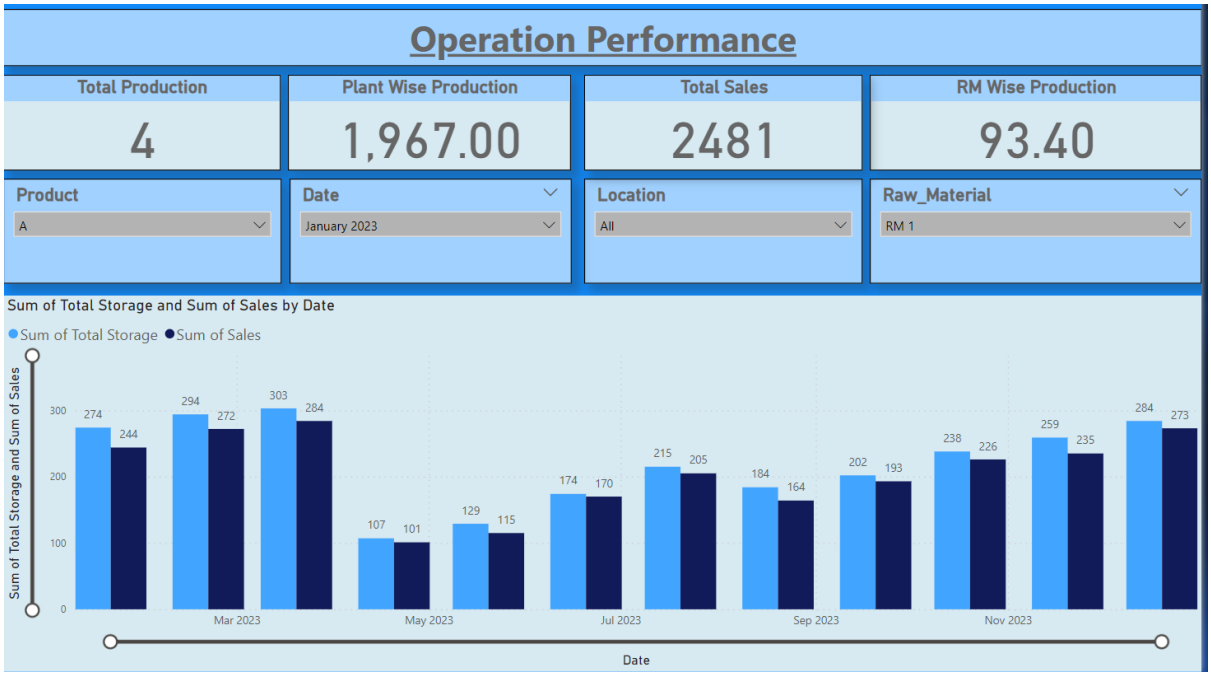

Fig 6.1 Operation

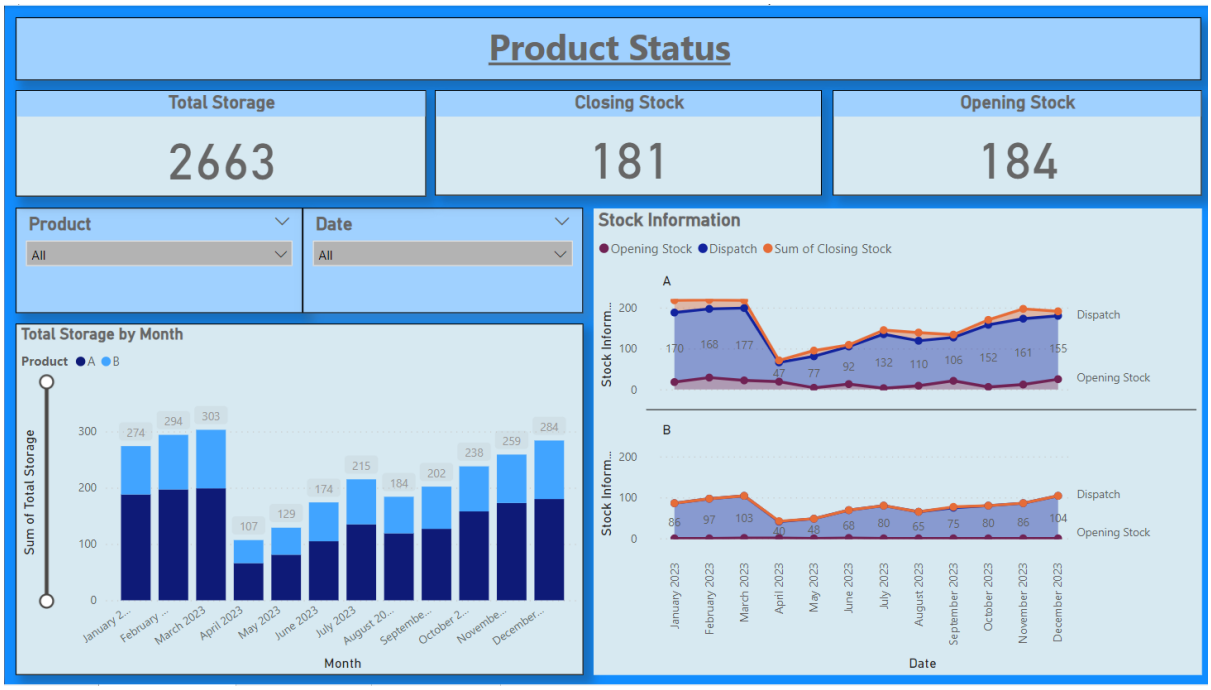

Fig 6.2 Product Status

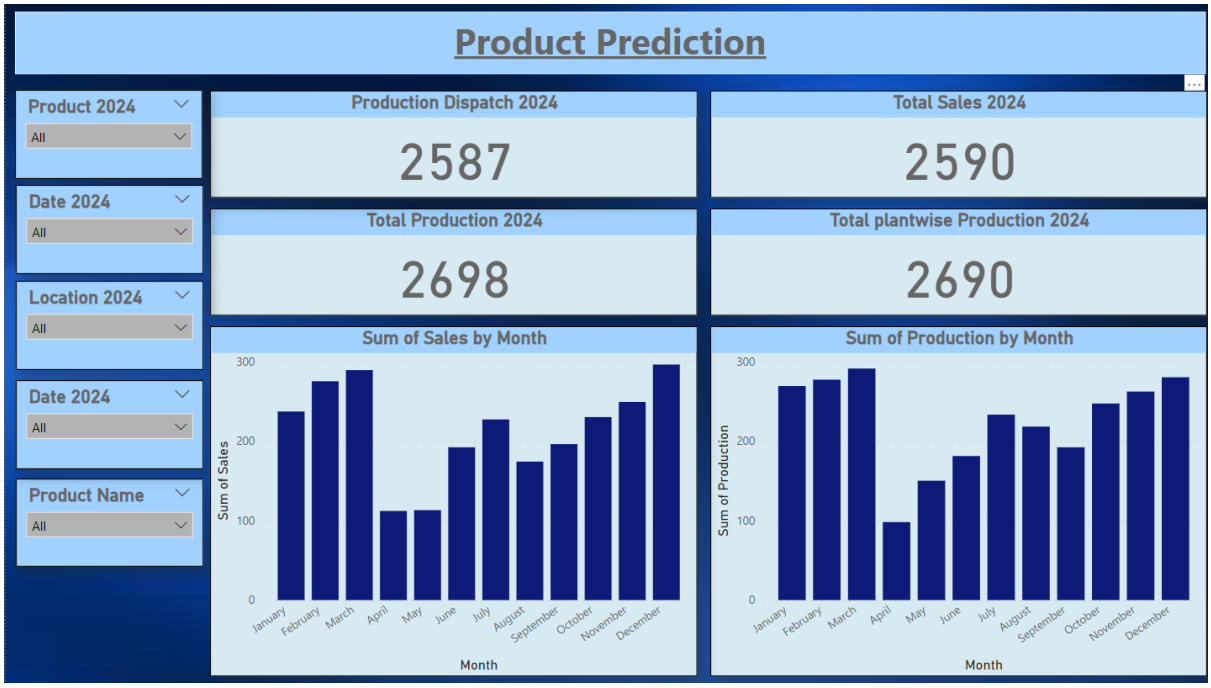

Fig 6.3 Product Prediction

- Key Performance Indicators (KPIs) The evaluation of the Industrial Dashboard's effectiveness begins with a detailed analysis of the key performance indicators. These KPIs encompass metrics such as data accuracy, dashboard responsiveness, user engagement, and the reliability of machine learning predictions. By assessing these KPIs, we gain insights into how well the dashboard meets its objectives and supports data-driven decision-making in industrial processes.

- Data Visualizations Data visualizations are at the heart of the Industrial Dashboard, serving as the primary means of conveying insights to users. This section explores the various data visualizations employed, including charts, graphs, and interactive dashboards. We analyze the effectiveness of these visualizations in simplifying complex industrial data and enabling users to grasp critical information quickly.

Chapter 7 - Project as Engineering Problem Analysis

7.1 Sustainability of the Project/Work

In this section, we assess the sustainability of the Industrial Dashboard project using Power BI. We evaluate its long-term viability, considering factors such as the scalability of the dashboard, its adaptability to evolving industrial needs, and the potential for future enhancements. By examining the project's sustainability, we aim to ensure that it continues to provide value to ADN Diginet and its stakeholders well into the future.

7.2 Social and Environmental Effects and Analysis

The analysis extends to the social and environmental effects of the project. We delve into how the Industrial Dashboard has influenced social aspects, such as user satisfaction, engagement, and collaboration within ADN Diginet's community. Additionally, we explore its environmental impact, particularly its contribution to reducing physical resource consumption through digital solutions. We recognize the importance of maintaining a balanced perspective between social and environmental considerations while advancing technological solutions.

7.3 Addressing Ethics and Ethical Issues

Ethical considerations are paramount in any engineering project. In this section, we thoroughly examine the ethical aspects of the Industrial Dashboard project. We address issues related to data privacy, responsible data handling, and the ethical implications of machine learning algorithms used in the dashboard. By addressing these ethical concerns, we emphasize ADN Diginet's commitment to responsible and ethical engineering practices, ensuring that the project aligns with ethical standards and societal values.

Chapter 8 - Lesson Learned

Data Collection Challenges
One of the key lessons learned during the development of the Industrial Dashboard project using Power BI was the significance of effective data collection. We encountered challenges related to data quality, accessibility, and consistency. This experience underscored the importance of establishing robust data collection processes and ensuring that data sources are reliable and well-maintained.

Data Cleaning and Preprocessing Complexities
Data cleaning and preprocessing proved to be intricate tasks in the project. The real-world data we worked with often contained errors, missing values, and inconsistencies. We learned the importance of thorough data cleaning to ensure the accuracy and reliability of insights generated by the dashboard. Additionally, we gained insights into the value of automated data preprocessing pipelines to streamline these tasks.

Feature Engineering Issues
Feature engineering, a critical aspect of machine learning, presented its own set of challenges. Crafting meaningful features from raw data required domain knowledge and creativity. We learned that feature engineering is not a one-size-fits-all process and that it demands a deep understanding of the problem domain to extract relevant information effectively.

Selection Dilemmas
Selecting the appropriate machine learning models was another lesson learned. We encountered dilemmas related to model complexity, interpretability, and performance. This experience highlighted the importance of model selection, evaluation, and the need for a balance between model sophistication and practicality.

Hyperparameter Tuning
Hyperparameter tuning, the process of optimizing model parameters, taught us the significance of fine-tuning models for improved performance. We realized that the choice of hyperparameters can significantly impact a model's effectiveness and efficiency. This lesson emphasized the iterative nature of machine learning model development.

Deployment Challenges
Finally, deploying the Industrial Dashboard and integrating it seamlessly with Power BI presented its own set of challenges. We learned that transitioning from a development environment to a production-ready solution requires careful planning and testing to ensure a smooth user experience.

8.1 Problems Faced During this Period

Throughout the project's duration, we encountered several significant challenges that tested our problem-solving abilities and prompted valuable lessons. Data quality and

consistency issues within industrial datasets required extensive cleaning and preprocessing, emphasizing the importance of robust data management. Limited computational resources necessitated optimization strategies and cloud-based solutions to handle machine learning complexities. Balancing model accuracy with interpretability was an ongoing challenge, especially when dealing with complex algorithms. Deployment complexities surfaced when integrating the Industrial Dashboard with Power BI, emphasizing meticulous planning. Ethical considerations surrounding sensitive industrial data underscored the need for stringent data privacy measures. Continuous learning and adaptation in the rapidly evolving data analytics landscape remained a perpetual challenge. Effective communication and collaboration within a multidisciplinary team were vital but demanded careful balancing, and planning for scalability was essential to ensure the system's future-proofing. Despite these challenges, each hurdle became an opportunity for learning and innovation, ultimately contributing to the project's success and equipping the team with valuable skills and insights for future endeavors.

8.2 Solution of those Problems

Throughout the course of the project, we encountered several challenges that required innovative solutions to ensure the project's success. One of the primary challenges was the quality and consistency of the data we collected and analyzed. To address this, we implemented a robust data cleaning and preprocessing pipeline, which involved identifying and rectifying outliers, handling missing values, and standardizing data formats. This meticulous approach ensured that the data used for analysis was reliable and accurate.

Another challenge revolved around the computational resources needed for complex machine learning tasks. To optimize resource usage, we transitioned to cloud-based solutions, enabling us to efficiently manage computational demands while maintaining performance.

Balancing the accuracy and interpretability of machine learning models was another hurdle. We tackled this challenge by incorporating explainable AI techniques, making the models more transparent and understandable to stakeholders.
Deployment complexities, particularly in integrating the solution with Power BI, were also addressed by seeking expertise from Power BI integration specialists, ensuring a seamless user experience and minimizing technical issues.

Data privacy was a paramount concern, especially when dealing with sensitive industrial data. To address this, we implemented stringent data privacy measures, including access controls, encryption, and anonymization techniques, safeguarding sensitive information while allowing for meaningful analysis.

Furthermore, continuous learning and skill development were critical in navigating the ever-evolving data analytics landscape. We fostered a culture of continuous learning through regular training sessions and staying updated with industry trends, enabling us to adapt and thrive in a rapidly changing field.

Effective communication and collaboration within our multidisciplinary team were essential. Regular meetings, clear project documentation, and collaborative tools ensured seamless coordination and minimized misunderstandings.

Lastly, to future-proof our system, we developed a scalability plan that considered potential increases in data volume and user load. This proactive approach involved selecting scalable technologies and designing the architecture with growth in mind.

By overcoming these challenges with innovative solutions, we not only achieved project success but also gained valuable insights and skills that will continue to benefit us in future data-driven endeavors.

Chapter 9 - Future Work & Conclusion

9.1 Future Works

In the realm of future endeavors, the Industrial Dashboard project is poised to embark on a journey of continuous enhancement and innovation. The project's primary objective will be to further bolster its machine learning capabilities, pushing the boundaries of predictive analytics and anomaly detection. Advanced machine learning algorithms, including deep learning models, will be explored and integrated to provide more precise insights into industrial processes. The incorporation of natural language processing (NLP) will enable the dashboard to analyze and interpret textual data, facilitating a deeper understanding of user feedback and external factors impacting operations.

Moreover, the project will extend its horizons to encompass broader data sources and integrate with a wider array of industrial equipment and sensors. This expansion will facilitate a holistic view of industrial operations, enabling organizations to optimize their processes comprehensively. Real-time data integration will be a focal point, enabling users to monitor operations as they happen, identify issues promptly, and implement corrective measures in real-time.

The project's commitment to sustainability will be further accentuated by a focus on energy-efficient algorithms and environmentally friendly practices. As industries increasingly adopt green and sustainable practices, the Industrial Dashboard will align itself with these objectives, providing organizations with tools to monitor and reduce their environmental footprint.

Additionally, the project will prioritize user training and support, ensuring that organizations can harness the full potential of the dashboard. Compliance with evolving data protection regulations, such as GDPR and CCPA, will be a continuous effort, safeguarding user data and privacy.

In summary, the future of the Industrial Dashboard project holds a promise of advanced analytics, real-time monitoring, sustainability, and user empowerment. It envisions a world where data-driven decision-making is not only efficient but also environmentally responsible, setting new standards for industrial excellence in the digital age.

9.2 Conclusion

In conclusion, the development and implementation of the Industrial Dashboard using Power BI, coupled with machine learning integration, has been a transformative journey. This project has demonstrated the immense potential of data-driven decision-making and the impact it can have on industrial operations. The dashboard's user-centric design and machine learning capabilities have empowered organizations to gain real-time insights, optimize processes, and make informed decisions, ultimately enhancing efficiency and competitiveness.

Furthermore, the project has underscored the importance of sustainability in today's technological landscape. By fostering a culture of ethical data practices, responsible resource management, and environmental awareness, it has set an example of how data-driven excellence can coexist harmoniously with ethical considerations and a commitment to a greener future.

The lessons learned, including overcoming data challenges, selecting appropriate machine learning models, and addressing ethical concerns, have equipped the team with valuable expertise for future endeavors. As the project looks ahead, it envisions continuous growth, with advanced machine learning techniques, broader data integration, and a focus on real-time monitoring and sustainability.

In essence, the Industrial Dashboard project represents a significant milestone in the journey toward data-driven excellence, responsible corporate citizenship, and a sustainable future. It exemplifies how technology, when harnessed responsibly, can drive positive change and innovation in the industrial landscape.

An Undergraduate Internship/Project

Power BI (DATA ANALYST)

By

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Consent from Supervisor

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