Development of

Supply Chain Management System for Bakery Product

A Practicum Report Submitted by

**Md Shahriair Alam**

**ID: 20103204**

In the Partial Fulfillment of the Requirements

for the Award of Bachelor of Computer Science and Engineering (BCSE)



Department of Computer Science and Engineering

College of Engineering and Technology

IUBAT – International University of Business Agriculture and Technology

Fall 2023

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The thesis has been examined and approved,

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Dept. of Computer Science and Engineering  
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**Tasnia Anjum Rifah**Supervisor and Lecturer  
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Fall - 2023

**Letter of Transmittal**

19 October 2023

The Chair

Practicum and Placemen Board

Department of Computer Science and Engineering

IUBAT–International University of Business Agriculture and Technology

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Dhaka 1230, Bangladesh

**Subject:** Letter of Transmittal.

Dear Sir,

With due respect, I would like to inform you that it is a great pleasure and a great pleasure for me to submit this report entitled “**Development of Supply Chain Management System for Bakery Product**” to complete my Practicum course.

It was a great opportunity for me to work on this project to make my theoretical knowledge more realistic and I gained a lot of exposure to the business culture of a famous company. I now look forward to your kind commentary on this performance report.

I will always be very grateful to you if you kindly go through this report and check my performance.

Sincerely Yours,

\_\_\_\_\_\_\_\_\_\_\_\_\_

Md Shahriair Alam

20103204

**Student’s Declaration**

I am Md Shahriair Alam, is student of the BCSE-Bachelor of Computer Science and Engineering program, under the College of Engineering and Technology (CEAT) of the International University of Business Agriculture and Technology (IUBAT) announcing this report entitled **“Development of Supply Chain Management System for Bakery Product”** has been prepared for the completion of the practicum course, which is part of the Bachelor of Computer Science and engineering degree.

The report of **“Development of Supply Chain Management System for Bakery Product”** was edited by me. All modules and procedures for this research are done after proper testing and online information.

It is not designed for other purposes, awards or presentations.

\_\_\_\_\_\_\_\_\_\_\_\_\_

Md Shahriair Alam

20103204

**Supervisor’s Certification**

This is to ensure that the practicum report on the **“Development of Supply Chain Management System for Bakery Product”** is compiled by Md Shahriair Alam, with ID #20103204, of IUBAT– International University of Business Agriculture and Technology, as part of the fulfillment of the required part of an effective practicum course. The report has been prepared under my supervision and is a record of the work accomplished, successfully completed. To the best of my knowledge and as per there declaration, no portions of this report have been posted anywhere by any degree, diploma or certificate.

You are now allowed to submit a report. I wish your every success in the future endeavors.

Practicum Supervisor

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Lecturer

Department of Computer Science and Engineering

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**Department’s Certification**

On behalf of the Department of Computer Science and Engineering, IUBAT-International University of Business Agriculture and Technology, I undersigned, confirm the performance report on ‘**Development of Supply Chain Management System for Bakery Product**’ for Bachelor of Computer Science and Engineering (BCSE) degrees was duly presented by Md Shahriair Alam (ID No: 20103204) and approved by the department.

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**Abstract**

**Acknowledgments**

Firstly, I want to give Almighty Allah to our sincere gratitude for His wonderful grace, which enabled me to successfully finish the thesis.

I would like appreciate and acknowledge all the people who has encouraged and supported me through the entire journey and has played a great role the completion of my Practicum and the report on “**Development of Supply Chain Management System for Bakery Product**”. First of all I would like to thank Almighty for uncountable and beyond to words reasons and for giving me the power to stay motivated all the time for completing any task. I want to thank my parents, who have endowed their immeasurable support and encouragement to attain this exquisite event of my life.

I would like to convey sincere thanks to our Vice Chancellor **Dr. Abdur Rab** for giving me an opportunity to submit this report. My outmost and sincere gratitude goes to **Prof. Dr. Utpal Kanti Das**, Chairman of Department of Computer Science and Engineering and **Rashedul Islam**, Coordinator of Department of Computer Science and Engineering for allowing me to work on the project.

I would like to thank our academic supervisor, **Tasnia Anjum Rifah**, Lecturer of the Department of Computer Science and Engineering of IUBAT-International University of Business Agriculture and Technology, who has encouraged me throughout the entire time and has provided me with all the necessary guidelines and support that I needed.

At last, I would like to thank Tohidul Islam (Technical Lead, Kodeeo Limited) for giving me the opportunity to complete my internship and project at Kodeeo Limited.

**INTERNSHIP CERTIFICATE**

**Chapter I. About Organization**

**1.1 Organization Overview**

Kodeeo Limited, located in Bangladesh, is a software development company specializing in IT consulting and services. The company excels in software development, website and mobile application design and development, as well as the implementation of e-commerce solutions. With a track record spanning four years, Kodeeo Limited has successfully executed projects of varying sizes, catering to end users, businesses, organizations, associations, and governmental entities.

The company's approach revolves around understanding and meeting client requirements. By deploying its professional team and strategic planning, Kodeeo Limited consistently achieves goals and objectives for the client's benefit. This approach is guided by a win-win mindset, unwavering commitment, and thorough planning to directly enhance customer outcomes. The seasoned professionals at Kodeeo Limited bring years of experience to the table, delivering client-centric solutions with a targeted focus.

**1.2 Organizational Service**

Kodeeo Limited offers a diverse range of services to its clients. The primary services rendered by Kodeeo Limited include:

* Software Development
* Mobile App Development
* Website Development
* E-commerce Website
* ERP
* Domain and Hosting

**1.2.1 Software Development**

A functional software or web application benefits businesses of all sizes to run better through digital transformation and modern capabilities. Kodeeo Limited plans, designs, develops, tests, deploys and maintains software and web applications to drive efficiency and effectiveness.

For building efficient and client satisfactory software’s Kodeeo Limited has the followings,

* Custom development, integration, migration, and maintenance programs are offered both in the cloud and on-premises. This includes creating connected mobile applications on iOS and Android platforms that use both native and cross-platform technologies.
* Knowledge of certified and trained engineers specializing in well-known cloud platforms such as AWS.
* Implementation of DevOps workflow automation, continuous integration and deployment pipelines and knowledge of micro services architecture and docking.
* Providing automated and manual software testing services for both software and products. Kodeeo Limited has been actively engaged in conceiving, structuring, and delivering technology and business solutions to its clientele.

**1.2.2 Website Development**

A company's online identity is encapsulated in its website. Websites play a pivotal role in enhancing brand or product awareness, ultimately influencing sales and brand recognition based on the company's objectives. Serving as a global introduction, a website shapes the company's image, fost

Kodeeo Limited specializes in constructing effective websites designed to increase search engine traffic. This involves creating fast-loading web pages with intuitive navigation and compelling design elements, facilitating more impactful global communication. Whether a company seeks a dynamic or static site, Kodeeo Limited is well-equipped to provide the desired solution.

Tailoring solutions to meet specific client requirements, Kodeeo Limited ensures the development of websites that effectively target potential customers, establishing a dynamic online presence for the company.

**1.2.3 Mobile App Development**

To ensure the success of a mobile app, it is crucial to evaluate objectives and consider the broader perspective. Kodeeo Limited enhances its clients' global reach by crafting and developing intuitive native mobile applications optimized for various operating systems such as Android and Windows.

Kodeeo Limited stands out for its proficiency in expanding user bases and formulating growth strategies, leveraging advanced machine learning processes that primarily focus on user behavior. This approach yields valuable insights for optimization and enhancement.

With a rich portfolio, Kodeeo Limited has collaborated on diverse projects, including B2B networking platforms, live tracking applications, delivery systems, event registration portals, and more. The development of top-tier mobile apps is facilitated by a team of individuals boasting over a decade of experience.

**1.2.4 Domain and Hosting**

Think of a domain name as your distinct online identity, much like how each person in your phone agenda has a unique name associated with their phone number. Remembering numerous phone numbers can be daunting, just as recalling specific IP addresses for websites is impractical. In essence, a domain name functions as a comprehensive online directory. When you input a company's URL or domain name, your browser communicates with the hosting provider's DNS server to fetch the website's IP address. This IP address, comparable to a phone number, allows your brows

At Kodeeo Limited, we pride ourselves on offering budget-friendly domain and hosting services, ensuring our clients have seamless access to these fundamental components for establishing and maintaining a robust online presence.

**1.3 Clients of the Organization**

The list of clients of Kodeeo Limited software company:

* Data Bangla
* Municipal Association of Bangladesh (MAB)
* WABMART Limited
* Barakah Fresh (Pvt.) limited
* Courier Bengal
* Bakeboss
* Directorate General of Drug Administration DGDA

**1.4 Organizations Expertise and Goals**

Kodeeo Limited clearly defines its objectives across essential parameters and adheres to established processes and standards to consistently measure and achieve success, remaining focused on the target. Each team member firmly believes there is no alternative approach. The elevated customer appreciation rating for Kodeeo Limited is indicative of their consistent delivery on these vital parameters.

The company excels in strengthening existing relationships, forging new ones, and venturing into unexplored markets. Collaborations with alliance partners extend Kodeeo Limited's reach into markets where they lack a direct presence. Clients can trust Kodeeo Limited to be their comprehensive partner in the respective field of expertise. The enduring vision of Kodeeo Limited is, and always will be, to contribute to the success of their clients.

**1.5 Organizational Mission**

At Kodeeo Limited, we utilize our technical proficiency and expertise to combine graphic design, web page architecture, interactive design, and database content. This integration allows us to strategize, construct, and implement e-business solutions, positioning us as a leading IT service provider.

**1.6 Organization Vision**

We are dedicated to turning imagination into reality! At Kodeeo Limited, we strive to establish enduring relationships with our clients, aspiring to be the future partners in their success. Our focus is on surpassing competitors by prioritizing customer engagement and commitment over the formulation of grand vision statements.

**1.7 My Position in the Organization**

I am currently interning in the website development division at Kodeeo Limited, where I report to Md Tohidul Islam. He is a gentle and humble individual who consistently tackles challenges with a unique perspective, emphasizing the importance of thinking outside the box for generating original ideas. My internship experience at Kodeeo Limited has been exceptionally positive, with a welcoming work environment and effective collaboration among team members. Being part of this organization has provided me with valuable opportunities to acquire new knowledge, and I am delighted to have the chance to intern at such a well-regarded company.

1.8 Organization Structure

**Chapter 2. Project Introduction**

**2.1 Introduction**

In the ever-evolving landscape of the bakery industry, where precision and efficiency are paramount, the adoption of a well-designed Supply Chain Management (SCM) system emerges as a strategic necessity. Bakeries, facing the dual challenges of fluctuating ingredient costs and the need to stay agile in response to dynamic market trends, find themselves at a crossroads. Conventional methods, often manual or lacking in organization, can result in operational inefficiencies and increased financial burdens.

This project report is dedicated to exploring the imperative of introducing a tailored SCM system in bakery operations. The primary focus is to optimize processes seamlessly, encompassing procurement, production, and distribution, ultimately leading to improved operational efficiency and the ability to meet the heightened demands of the market

The report will thoroughly examine the project's objectives, delving into the key components of the proposed SCM system, exploring opportunities for technology integration, and projecting the anticipated benefits for bakery operations. By simplifying complex processes and harnessing the power of practical technology solutions, this project aspires to empower bakeries, enabling them to navigate challenges adeptly and meet consumer expectations with ease in the competitive bakery market. Throughout the report, emphasis will be placed on the simplicity and practicality of the proposed SCM system to make it accessible and beneficial for bakery stakeholders at all levels.

**2.2 Project Overview**

The Supply Chain Management System (SCMS) project is designed to manage the way organizations based on their supply chain processes. In the contemporary business landscape, characterized by globalization, the SCMS aims to enhance efficiency, transparency, and collaboration manner within the supply chain. The primary objectives of the project include improving operational efficiency, providing real-time visibility into the entire supply chain, fostering collaboration among stakeholders, enabling data-driven decision-making, and automating routine processes. Key features of the SCMS encompass supplier management, inventory optimization, order tracking and fulfillment, collaborative planning, data analytics, and reporting, as well as security and compliance measures. By implementing the SCMS, organizations anticipate cost reduction, improved customer satisfaction, strategic decision-making capabilities, and increased agility to adapt to dynamic market conditions. Ultimately, the SCMS project seeks to create a flexible and adaptable supply chain system that aligns with the evolving needs of businesses in today's complex environment.

**2.3 Objectives**

The central aim of the Supply Chain Management System Project is to effectively handle the details pertaining to Customer, Product, Order, and Shipment. It comprehensively manages information related to Customer, Delivery, and Product. The project is exclusively constructed for administrative use, ensuring that only the administrator has guaranteed access. Its overarching goal is to develop an application program that reduces manual efforts in handling Customer, Product, Delivery, and Product Company details. The system meticulously tracks information about Product Company, Order, and Shipment.

The key points of this project encompass:

* Enhancing the efficiency of procurement processes to ensure the timely and cost-effective of raw materials.
* Optimizing planning and scheduling to improve resource utilization and minimize time.
* Strengthening relationships with suppliers through the implementation of a collaborative Supplier Relationship Management (SRM) platform.
* Improving distribution and logistics to guarantee timely and cost-efficient product delivery.

**2.4 Scope of the project**

It can facilitate the meticulous gathering of detailed management information, ensuring a clear, straightforward, and meaningful collection in a short period. This aids individuals in gaining a precise and vivid understanding of the past year's management. Furthermore, it supports ongoing tasks related to the Supply Chain Management System, contributing to streamlined and cost-effective management collection procedures

Our project is centered on Business Process Automation, signifying our efforts to automate various aspects of the Supply Chain Management System. Within a computerized system, individuals are required to fill out various forms, and multiple copies of these forms can be easily generated simultaneously. Additionally, the computer system eliminates the need to manually create manifests; instead, they can be directly printed, saving valuable time. The project's objectives include assisting staff in capturing efforts in their respective work areas, enhancing resource utilization through automation for increased productivity. The system generates various types of information that can be utilized for diverse purposes, satisfying user requirements with an easy-to-understand interface for both users and operators. The system is designed to be easy to operate, possess a good user interface, be expandable, and be delivered on schedule within the specified budget.2.5 Methodology

The creation of the "Supply Chain Management System" has followed an incremental model, aligning with the structural framework outlined in Software Analysis and Design. This preliminary study on the development of the Supply Chain Management System emphasizes its early stages, with a focus on establishing a foundational understanding of the system's structure and functionality. The incremental approach adopted in the development process ensures a systematic and iterative enhancement of the system, aligning with best practices in software engineering for a comprehensive and effective Supply Chain Management System.

**2.6 Limitation of the project**

As mentioned earlier in this report, an internship serves as a bridge connecting theoretical knowledge to practical application. The internship program at IUBAT has provided me with a valuable opportunity to witness the translation of theory into real-world practice. Initially, upon joining the organization, I encountered numerous conditions and systems that were unfamiliar to me. Over time, however, I have become accustomed to these terms and have learned from the experiences of older classmates and friends who have undergone similar adjustments. It's important to note that a limitation of this internship project is the constraint of time. Developing comprehensive software within a short timeframe is a challenging task, even with the application of software engineering techniques. Consequently, the scope of the internship project had to be narrowed due to these time constraints.

**2.7 Process model**

I chose incremental process model to develop this project. The Incremental Process Model is a software development methodology that prioritizes breaking down the development process into smaller, manageable parts called increments. Each increment shows a part of the overall system operation and is developed separately. The development team works on one increment at a time, delivering a partial system that can be tested and integrated into the existing system. This approach allows us for continuous development, testing, and refinement of the software in incremental steps.

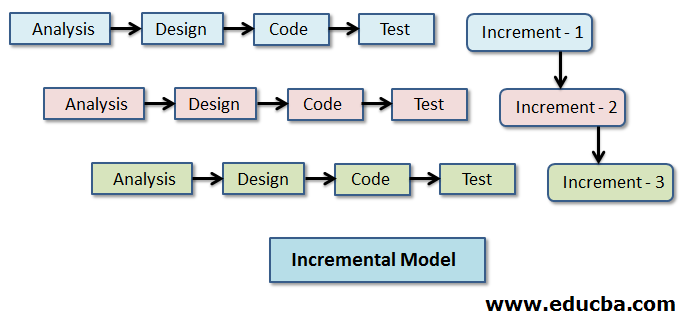


Figure 2.1 Incremental Process Model

**2.7.1 The reason for Incremental Process Model**

The Incremental Process Model offers several advantages in the software development lifecycle, contributing to a more flexible and adaptive approach. Here are some key advantages:

* Early Delivery: Provides functional parts of the system early in the development process.
* User Feedback: Facilitates continuous user feedback and involvement throughout development.
* Risk Reduction: Smaller increments reduce the overall risk of project failure.
* Flexibility: Adaptable to changing requirements, allowing easy incorporation of modifications.
* Testing Efficiency: Focused testing on specific functionalities simplifies identification and resolution of issues.
* Early Core Features: Core functionalities can be implemented early, forming a foundation for subsequent increments.
* Client Satisfaction: Regular delivery of usable features enhances client satisfaction.
* Resource Optimization: Efficient use of resources as teams focus on specific, manageable increments.

**2.8 Feasibility Study**

A feasibility study involves a comprehensive assessment and analysis to determine the practicality, viability, and potential success of a proposed project or business venture. This evaluation takes place before the project initiation to assess its merit. The study's objective is to equip stakeholders, including investors, management, and decision-makers, with the essential information required to make informed decisions about pursuing the project.

There are three main feasibility studies are:

* Technical feasibility
* Economic feasibility
* Operational feasibility

**2.8.1 Technical Feasibility**

Technical feasibility involves evaluating whether a proposed project or system can be successfully developed and implemented using available technology and resources. This assessment focuses on key aspects such as technology requirements, the expertise and skills of the project team, compatibility with existing systems, identification of potential technical risks, estimation of technology costs, and the availability of technical support for ongoing maintenance. A positive technical feasibility analysis suggests that the project can be effectively executed from a technological standpoint, while any identified challenges may prompt adjustments to the project scope, technology choices, or resource allocation. Technical feasibility is a crucial consideration in the overall feasibility study conducted before committing resources to a project.

**Hardware/Software Requirements:**

* Operating System (Windows 7 or more)
* Ram (4 GB or more)
* Web Browser (chrome or any suitable one)

**Developing Tools**

* Composer
* Visual Studio code
* PHP (Laravel Framework)
* XAMPP Server (MySQL)

**2.8.2 Economic Feasibility**

The objective of an economic feasibility evaluation is to ascertain the favorable economic advantages that a proposed system will bring to an organization. Our system demonstrates economic viability as it enables the completion of numerous tasks in a short time, tasks that cannot be simultaneously achieved by human efforts. Additionally, the system diminishes the workforce needed to manage products, order details, customer information, and payment details. Consequently, if the existing system demands a significant number of employees, the expenses associated with personnel decrease, resulting in cost savings.

**2.8.3 Operational Feasibility**

Operational feasibility involves evaluating whether a proposed project or system can be seamlessly integrated into an organization's current operations. This assessment examines the impact on daily activities, resource availability, training requirements for staff, alignment with organizational goals, user acceptance, legal compliance, scalability, and the development of a transition plan. The goal is to determine whether the proposed solution can be effectively implemented within the existing operational framework, minimizing disruptions and ensuring a smooth integration. A positive operational feasibility assessment indicates that the proposed project is likely to be operationally successful and align with the organization's strategic objectives. Identified challenges may necessitate adjustments to the project plan or a reevaluation of the proposed solution.

**Chapter 3. Requirement Engineering**

3.1 Requirement Analysis

The requirement analysis serves as a tool for the software designer to convert data, architectural, interface, and component level designs into information, function, and behavior. The completion of requirement analysis occurred during the task phases outlined in this chapter.

3.2 Requirement Engineering

Requirements engineering, as implied by its name, is a branch within engineering dedicated to the development of software systems and the identification of user needs. While various definitions exist for requirements engineering, they all converge on the idea that it revolves around comprehending user expectations for a computer system and deciphering the implications of these requirements on the design. This field shares close ties with software engineering, which principally concentrates on the process of constructing systems aligned with customer preferences.

The following requirements will be covered in this project-

* User requirements
* System requirements
* Functional requirements
* Non-Functional requirements

**3.2.1 User Requirements**

The Supply Chain Management System has 6 types of users,

1. Admin
2. Supplier
3. Manufacturer
4. Retailer
5. Distributor
6. Customer

The user requirements of the project Supply Chain Management System are as follows:

**Admin**

1. Admin can login to the system by username and password. Admin does not need to register to the system.
2. Admin can add other users and delete them.
3. Admit can add raw materials, products and also can delete and edit them.
4. Admin can manage category and unit of products.
5. Admin can see order status and recently placed order list.
6. Admin can generator reports for every section.

**Supplier**

1. Supplier can login to the system by user name password and doesn't need to register.
2. Supplier can see the product list but cannot update them.
3. Supplier can add, edit and delete raw materials.
4. Supplier can receive order of raw materials from the manufacturer.
5. Supplier can generate the report only for raw materials.
6. Supplier can manage unit of raw materials.
7. Supplier can see other users but cannot delete and edit them.

**Manufacturer**

1. Manufacturer can login to the system by username and password.
2. Manufacturer can see the raw materials list but cannot delete and edit them.
3. Manufacturer can place order to the supplier for the raw materials.
4. Manufacture can see the stock of raw materials.
5. Manufacturer can see the other users but cannot update them.
6. Manufacture can generate report only for the raw materials.
7. Manufacturer can communicate with the distributors.
8. Manufacturer can upload the product, edit and delete them, also can manage the category.

**Distributor**

1. Distributors can login to the system by using username and password.
2. Distributors can see raw materials list but cannot update them.
3. Distributors can add products, edit and delete them.
4. Distributor can manage product category and the report of products.
5. Distributor can see the other users but cannot delete them.
6. Distributor can communicate with the retailer.

**Retailer**

1. Retailer can login to the system by username and password.
2. Retailer can see the raw materials but cannot edit and delete them.
3. Retailer can receive the order of bakery products from the customer.
4. Retailer can add product and edit and delete them.
5. Retailer can manage the payment of customer.
6. Retailer can generator the invoice.
7. Retailer can delete the registered customer.
8. Retailer can manage the shipment.
9. Retailer can add the delivery man, also delete them and assign task for delivery the products to the customer.

**Customer**

1. Customer can visit website and can see the all of category of products.
2. Customer can register and login to the system.
3. Customer can view the products.
4. Customer can place order and make payment.
5. Customer can track the delivery man.
6. Customer care see the invoice and download the invoice
7. Customer can communicate with the retailer.

**Chapter III. Research Methodology**

3.1 Recap of the research questions

The research question focuses on the development of an intelligent career guidance system that utilizes machine learning algorithms to provide accurate and personalized career advice to users. This research question aims to investigate the various machine learning algorithms that can be used to analyze the user's personal and professional characteristics, identify their skills, strengths, weaknesses, and interests, and suggest suitable career paths based on their profile. This question requires exploring the existing literature on the various machine-learning techniques and determining which algorithms are most effective in predicting and recommending career options. Then another research question focuses on the design and development of a user-friendly interface for the intelligent career guidance system. This question requires investigating the various design principles and guidelines for developing a user interface that is intuitive, easy to use, and aesthetically pleasing. The research will also investigate the usability of the system and gather feedback from users to improve the interface and overall user experience.

Another research question aims to evaluate the effectiveness of the intelligent career guidance system in terms of its accuracy, reliability, and usefulness. This research question requires conducting a series of tests to measure the system's ability to accurately predict and recommend suitable career paths for users. The research will also investigate the reliability of the system by comparing its recommendations to those of human career advisors. The usefulness of the system will be evaluated by gathering feedback from users on the quality and relevance of the career advice provided by the system.The next research question focuses on the ethical implications of using machine learning algorithms in career guidance. This research question requires investigating the potential ethical concerns that may arise from using machine learning algorithms to predict and recommend career paths. The research will investigate issues such as bias, privacy, and transparency and develop ethical guidelines for the use of machine learning algorithms in career guidance.

Overall, the research questions in this thesis topic aim to investigate the development of an intelligent career guidance system using machine learning algorithms, focusing on the design and development of a user-friendly interface, evaluating the effectiveness of the system, and investigating the ethical implications of using machine learning algorithms in career guidance. By addressing these research questions, the thesis will contribute to the development of a more accurate, personalized, and ethical approach to career guidance, which can help individuals make informed decisions about their careers and achieve their professional goals.

3.2 Description of the method

Selecting the right algorithm for implementing machine learning can be a daunting task. It's essential to preprocess data before using algorithms to avoid bad results. In a study, two algorithms were used to recommend careers for students, and the k-nearest neighbor was found to be the most accurate. Data preparation and preprocessing are crucial steps in the proposed methodology. After preprocessing, algorithms were applied, and the results were compared to determine the best algorithm. Therefore, selecting the right algorithm and preprocessing data can significantly improve the accuracy of machine learning outcomes.

In figure 3.2.1 the proper steps of the proposed methodology are encapsulated below:

Dataset

Label Encoding

Data Splitting

Data Preprocessing

Trained model

Training Data

Testing Data

Training the model

Performance evaluation

* Filling Missing Data
* Correct Spelling Mistake
* Remove Stop Word

Figure: 3.2.1 Proposed methodology of work

FIGURE: 3.2.1 PROPOSED METHODOLOGY OF WORK

FIGURE: 3.2.1 PROPOSED METHODOLOGY OF WO RK

Figure 13.2.1 Proposed methodology of work

3.3 Dataset Description

Due to difficulties with collecting datasets, we resorted to using dummy datasets that were specifically created from a Bangladeshi career perspective. Although dummy data does not contain any valuable information, it can be used to reserve space for real data and for both operational and testing purposes. We used dummy datasets for testing purposes by creating questions related to students' interests, academic backgrounds, and environmental situation. By gathering the answers to these questions, we can predict the appropriate field of study for a specific student. Various fields of study were included so that students could choose their own area of study by answering questions to a machine, which could also determine their future job opportunities based on their interest’s chart of the data reveals that we included ten distinct areas of study in our dummy dataset to obtain the recommended output for students. We used ten categories to suggest the best field of study for each student.

In figure 3.3.1 the illustration of our dataset has been given below:

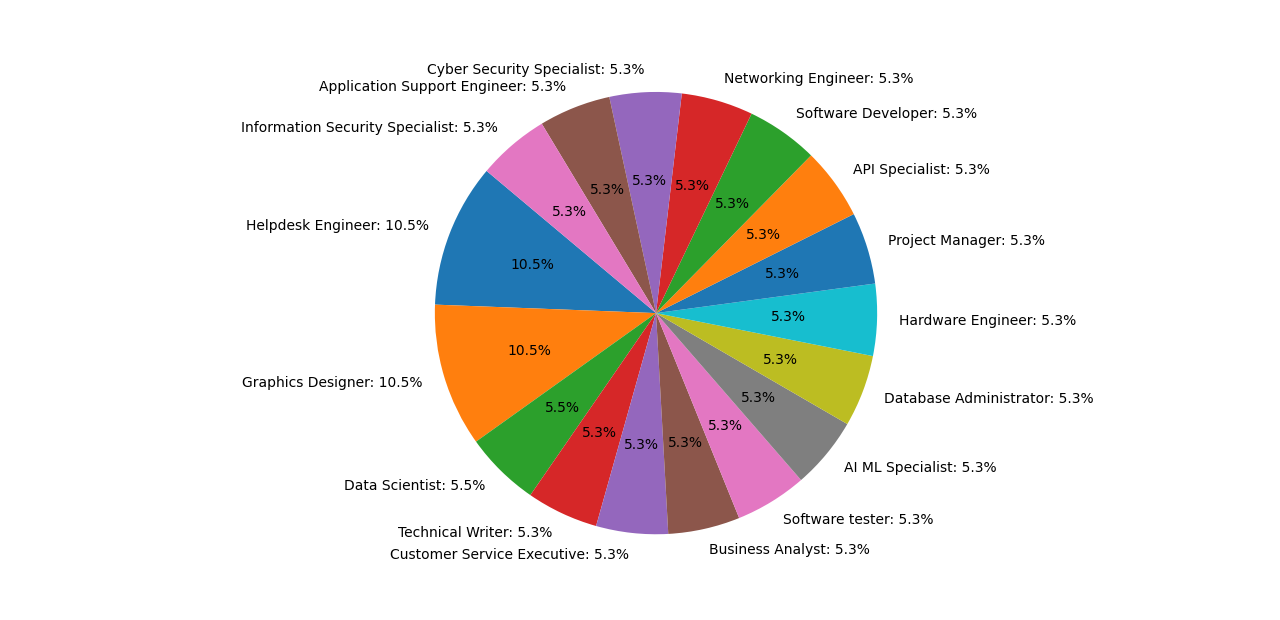


Figure 3.3.1 The illustration of our dataset

#### Data Statistics

Statistics of my Dataset –

TABLE 3.3.1: DATA STATISTICS

|  |  |
| --- | --- |
| Names | Numbers |
| Question of skillsets | 17 |
| Categories | 17 |
| Students | 100000 |

The table indicates that the questions and categories of skillsets pertain specifically to computer skills and that there are more than 1000 students involved in this scenario. This suggests that the questions and categories of skillsets are likely related to computer programming, IT, or another field of technology and that the students in question are likely studying or training in this area.

3.4 Data preprocessing

Data preprocessing in machine learning involves a series of essential steps to prepare raw data for model training and evaluation. This includes addressing missing values, outliers, and errors in the dataset, transforming categorical variables into numerical formats, scaling features for uniformity, splitting data into training, validation, and test sets, and potentially reducing dimensionality for efficiency. Proper data preprocessing ensures that the data is cleaned, organized, and structured in a way that facilitates the training of machine learning models, leading to more accurate and reliable results when making predictions or drawing insights from the data.

#### 3.4.1 Handling Missing Data

Missing data is a common issue in datasets, and it can result in biased or inaccurate results if not handled properly. This preprocessing technique involves dealing with missing values in a dataset. Several strategies for handling missing data include removing rows or columns with missing values, imputing missing values with statistical measures (such as mean, median, or mode), or using more advanced techniques like interpolation or predictive modeling to estimate missing values.

##### Mode Imputation Technique:

Mode imputation is a simple and commonly used method for handling missing data in categorical features. It helps to ensure that your dataset remains complete, which is important for training machine-learning models. However, it may not always be the best approach, as it can introduce bias if the missing data is not missing completely at random or if the mode is not a representative value for the missing cases. Other imputation techniques like mean imputation for numerical variables or more advanced methods like K-nearest neighbor’s imputation can be considered depending on the nature of your data and the problem you are trying to solve.

|  |
| --- |
| **Database Fundamentals** |
| Professional |
| Professional |
| Average |
| Poor |
|  |
| Beginner |

|  |
| --- |
| **Database Fundamentals** |
| Professional |
| Professional |
| Average |
| Poor |
| Professional |
| Beginner |

Figure 3.4.1.1 The illustration of missing data

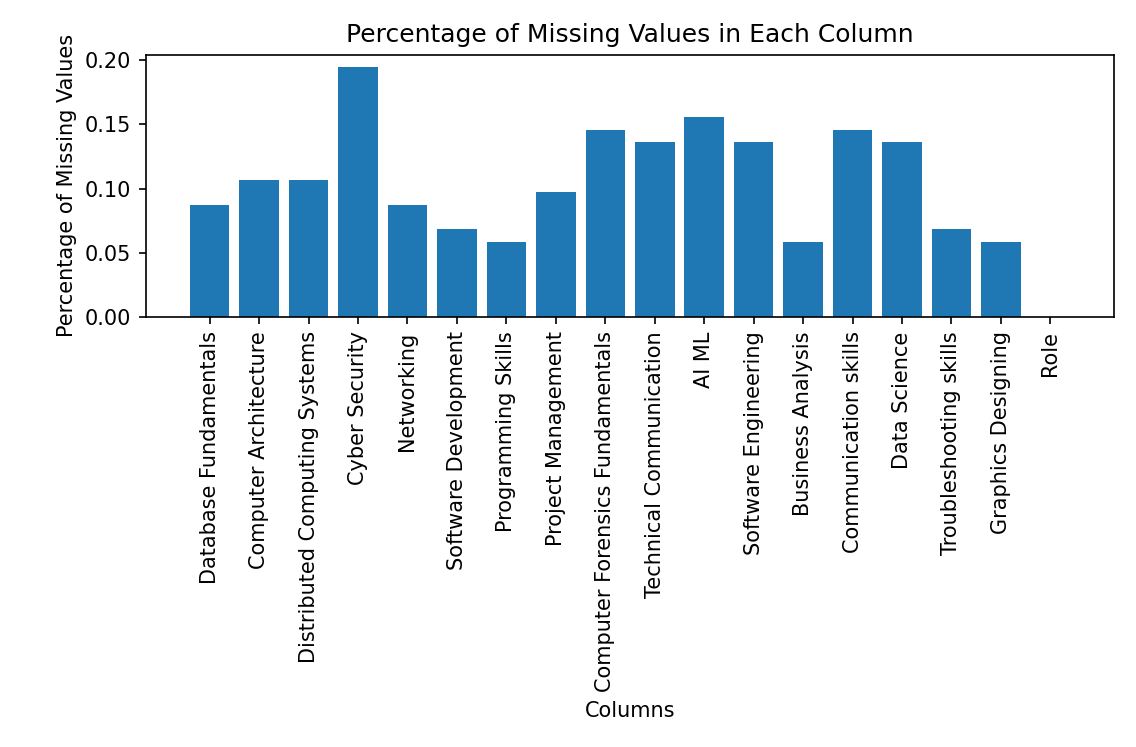


Figure 3.4.1.2 Percentage of missing value in each column

After applying the mode imputation technique, the data set column look like-

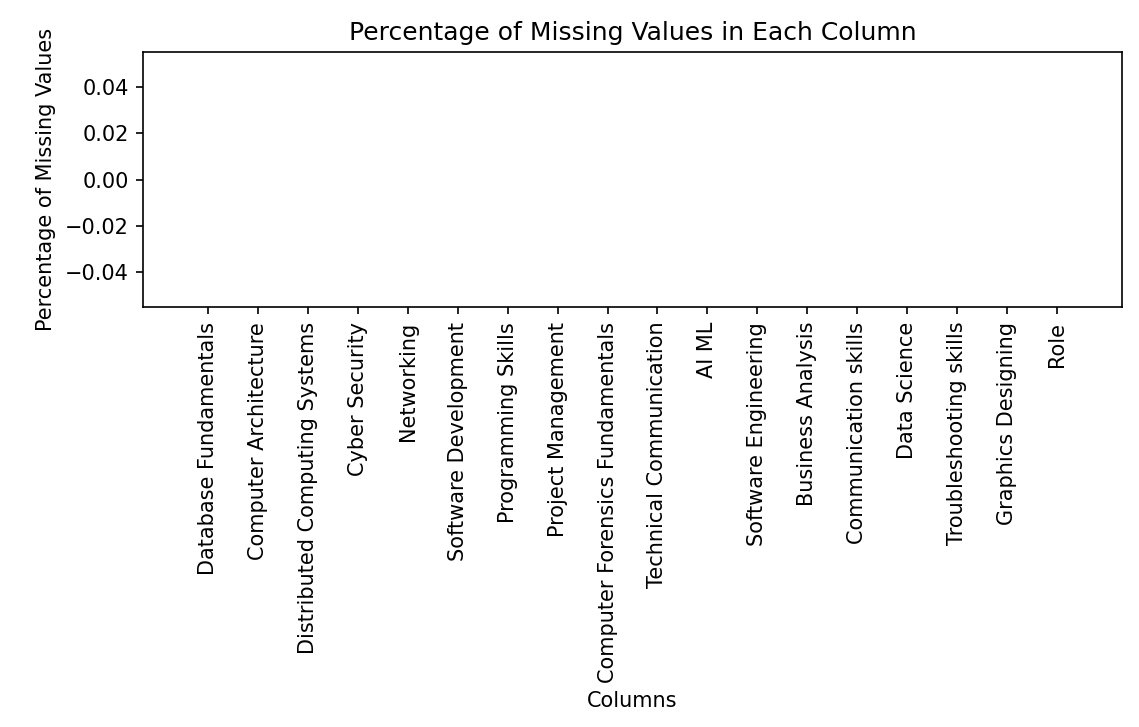


Figure 3.4.1.3 Percentage of missing value in each column

#### 3.4.2 Correct Spelling Mistake

Correcting spelling mistakes in machine learning typically involves using natural language processing (NLP) techniques. Correcting spelling mistakes in machine learning is a common NLP task and is vital for improving the user experience in various applications involving text input and processing. It's worth noting that modern spell checkers often use more advanced techniques, including deep learning models like transformers, to achieve high accuracy in correcting spelling mistakes. It employs a dictionary to define valid categories for different fields and utilizes fuzzy string matching to find and replace categories with their closest valid counterparts, ensuring data consistency. This approach is commonly used to clean and correct categorical data before further analysis or modeling.

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| **Database Fundamentals** |
| Professional |
| Professional |
| Average |
| Poor |
| Professional |
| Beginner |

Figure 3.4.2.1 The illustration of spelling mistake

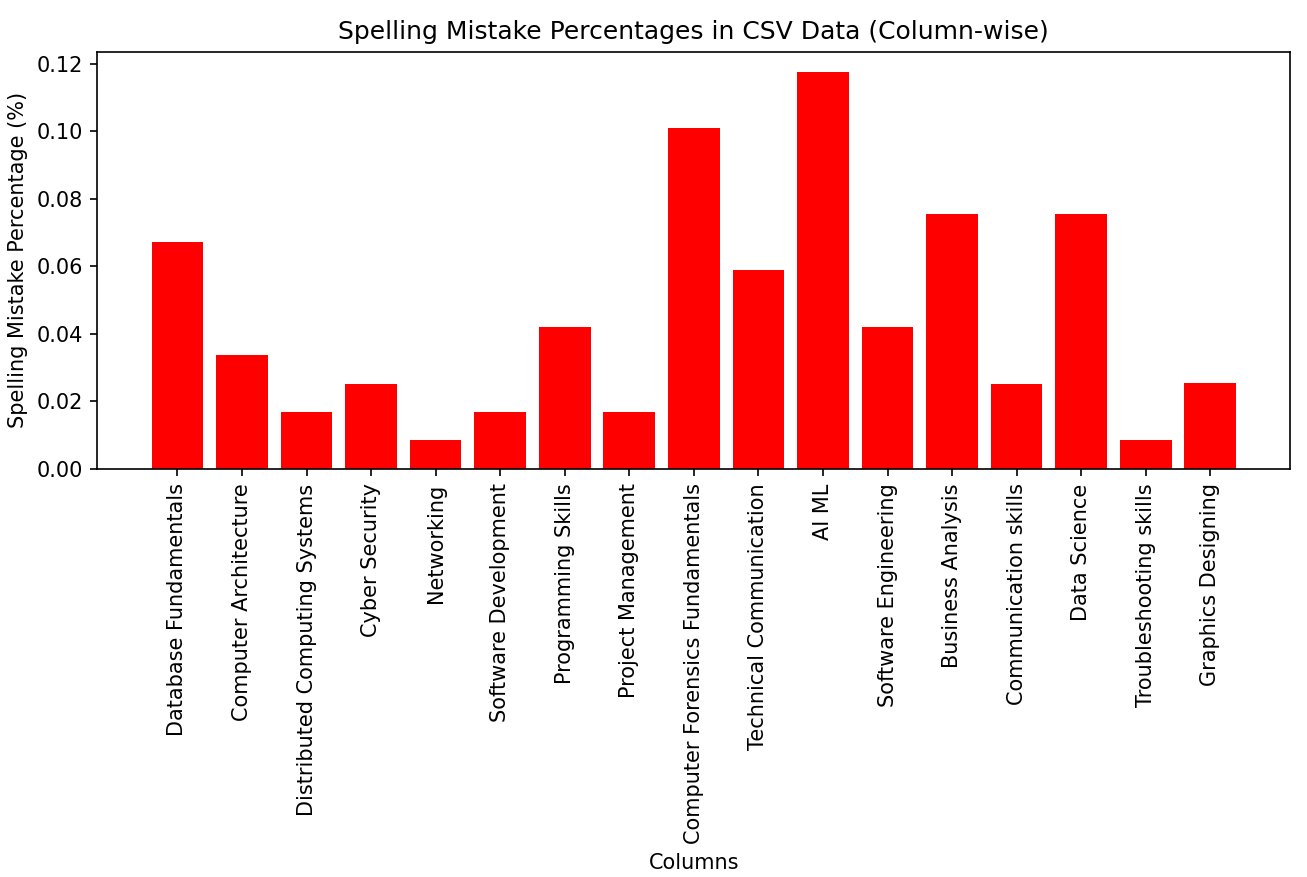


Figure 3.4.2.2 Showing percentage of mistake for each column

After applying fuzzy string matching technique for each column, we have removed the spelling mistake. The updated dataset spelling missing percentage look like-

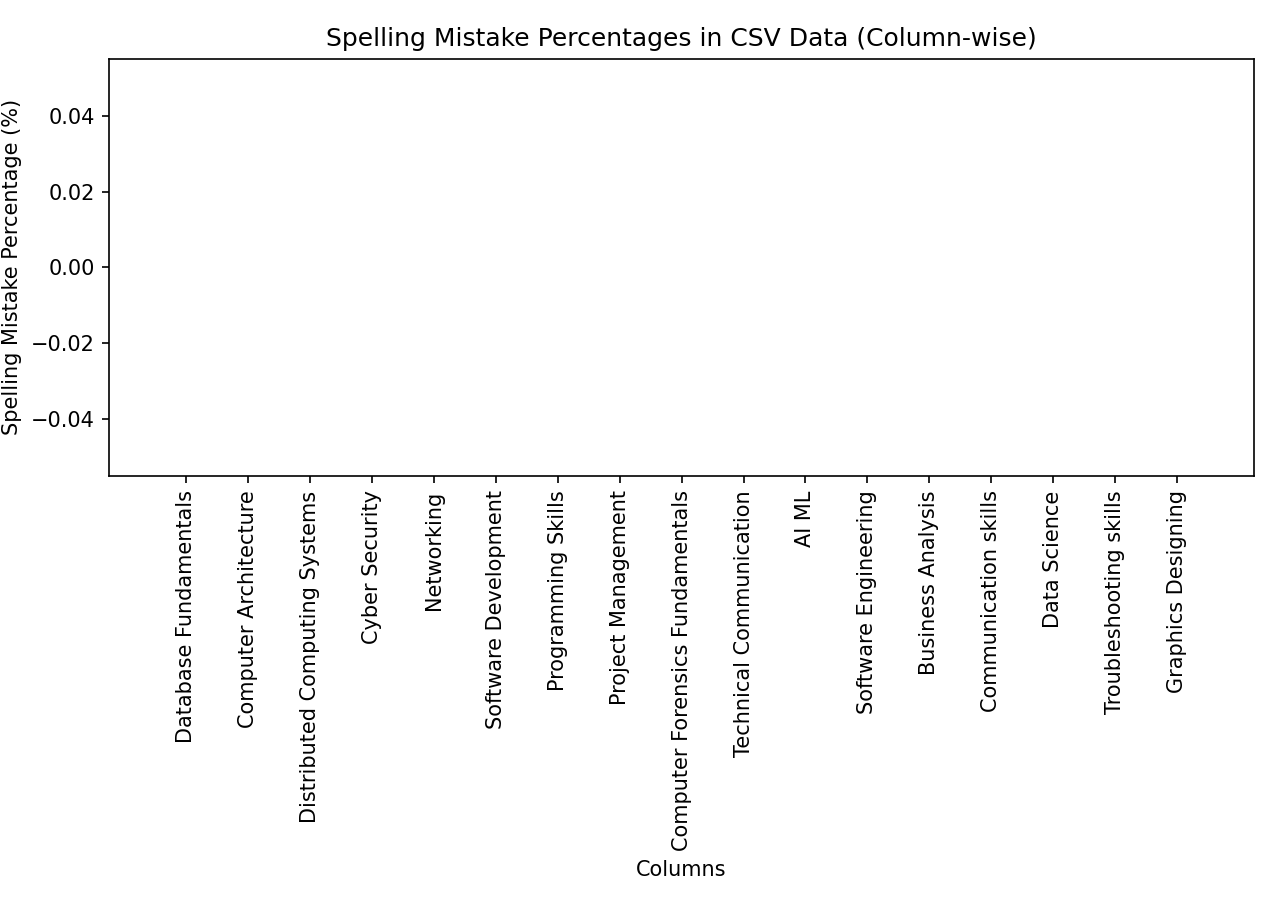


Figure 3.4.2.3 Showing percentage of mistake for each column

#### 3.4.3 Remove Stop word

Removing stop words is a standard text preprocessing method in natural language processing (NLP) that involves eliminating common words, such as "the," "is," "and," and "in," from a text. These words are considered low informational value because they appear frequently in most textbooks and don't carry specific meanings. By removing stop words, NLP models can focus on more meaningful text content, leading to better outcomes in tasks like sentiment analysis, text classification, or information retrieval. It's a fundamental step to reduce noise and improve the efficiency of text analysis.

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| Average |
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| **Database Fundamentals** |
| Professional |
| Professional |
| Average |
| Poor |
| Professional |
| Beginner |

Figure 3.4.3.1 The illustration of Stop word process

Before removing the stop word from our dataset the percentage of the stop of our dataset -

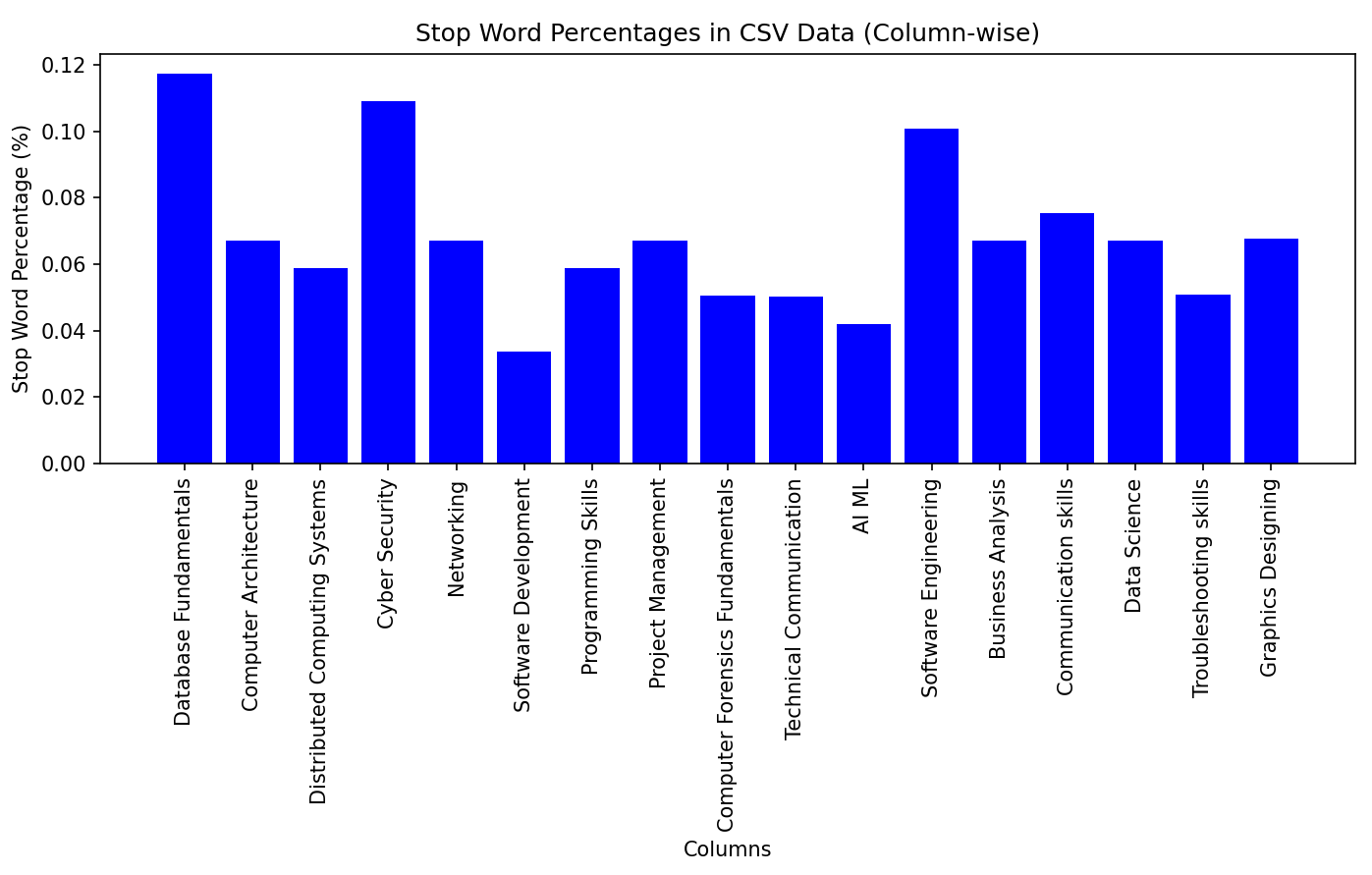


Figure 3.4.3.2 Showing percentage of stop for each column

Apply NLTK by importing it, preprocessing text, tokenizing (splitting) it, optionally removing common words (stop words), and conducting text analysis or machine learning tasks as needed, with iterative refinement and proper documentation. After applying-

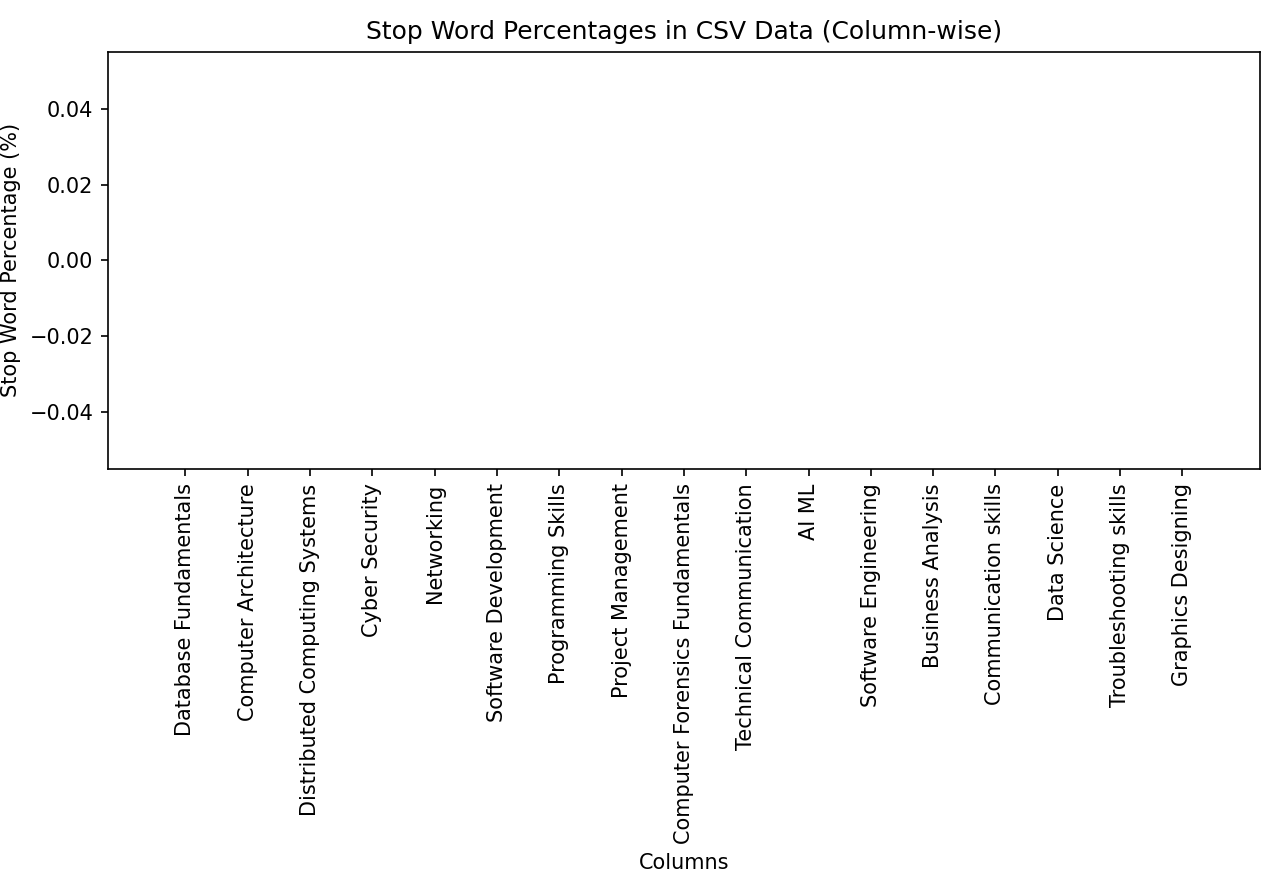


Figure 3.4.3.3 Percentage after removing stop word

3.5 Machine Learning Algorithms

The way in which an AI system performs its task, typically making predictions of output values based on input data, is referred to as a machine-learning algorithm.

#### 3.5.1 Naïve Bayes

Naïve Bayes is a classification method that relies on Bayes' Theorem, assuming that the predictors are independent. Essentially, the Naive Bayes classifier assumes that the existence of a particular feature in a category is not connected to the existence of any other feature. The Naive Bayes algorithm is adaptable for various applications, including real-time predictions, multi-class predictions, text classification, sentiment analysis, and recommendation systems.

Bayes' theorem offers a method for computing the posterior probability P(A|B) using P(A), P(B), and P(B|A).

The formula:

Where -

P(A|B) = Posterior Probability of the Hypothesis given that the Evidence is True

P(B|A) = Likelihood of the Evidence given that the Hypothesis is True

P(A)= Prior Probability of the Hypothesis

P(B)= Prior Probability that the evidence is True

3.5.2 K-NN algorithm

Given that we are developing a recommendation system, the k-NN algorithm is a suitable option for our dataset. The k-nearest neighbor (k-NN) algorithm is a supervised machine learning technique that can be used for both classification and regression tasks, although it is mainly used for classification in the industry. It works by calculating the distance between data points, which is done using the Euclidean Distance formula.

Formula:

The Euclidean Distance formula can be used to calculate the distance between two points in 2-dimensional space. This formula is commonly known as the Euclidean distance formula and is widely used for measuring distances in the plane.

If we consider two points (x1, y1) and (x2, y2), the distance between them can be calculated using the Pythagorean Theorem as follows:

(x2, y2)

d

(y2-y1)

(x1, y1)

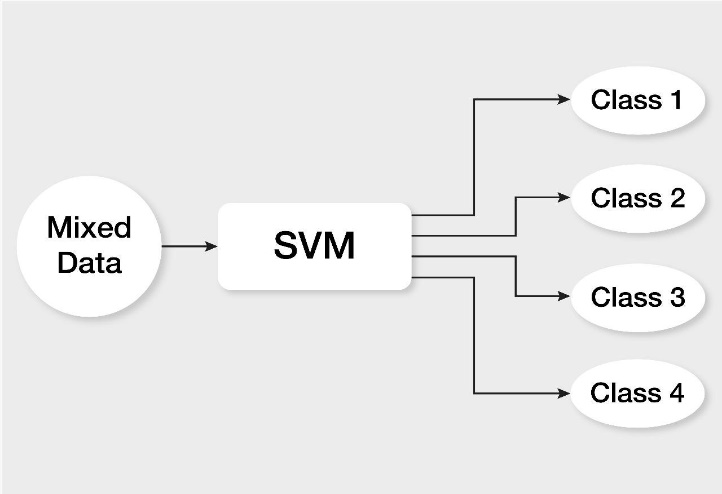
(x2-x1)

The Euclidean distance between (x1, y1) and (x2, y2) is,d = √ ((x2 - x1) ^2 + (y2 - y1) ^2)

So, in short form,

#### 3.5.3 Support Vector Machine

Support Vector Machine (SVM) is an algorithm in machine learning for classification and regression tasks. Its core objective is to find the best possible separation (hyperplane) between different categories or to make predictions based on existing data. It is particularly adept at handling situations where data points belong to other groups and must be divided as clearly as possible. SVMs excel in simple and complex scenarios, offering an excellent tool for various machine learning problems, from image recognition to financial forecasting.

SVM works by finding a hyperplane that maximizes the margin between different classes of data points in a high-dimensional space. It can handle both linear and non-linear classification problems through the use of kernel functions, making it a versatile and powerful machine learning algorithm for various applications.

**FIGURE: 3.2.1 PROPOSED METHODOLOGY OF WO**

FIGURE: 3.5.2.1 Fuzzy Logic

Figure 3.5.3.1 SVM Classes



Figure 3.5.3.2 SVM Visualization

#### 3.5.4 Decision Tree

A decision tree is a versatile machine learning algorithm used for classification and regression tasks. It constructs a tree-like structure where each internal node represents a feature-based decision, and each leaf node provides a predicted outcome. The algorithm recursively partitions the data column into subsets, choosing the best feature at each step to maximize the separation between classes (for classification) or minimize error (for regression). Decision trees are interpretable and capable of capturing complex relationships in the data, but they can be prone to overfitting. Techniques like pruning and setting appropriate parameters help mitigate this issue, and decision trees serve as the foundation for ensemble methods, such as Random Forests, which enhance predictive accuracy by combining multiple decision trees. We have used classification approach.

Decision trees for categorical datasets:

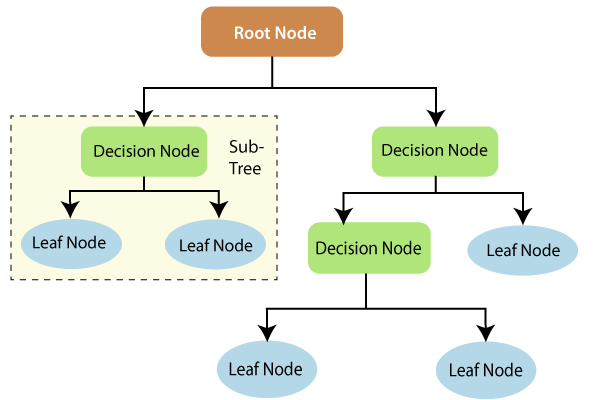
* Choose the best categorical attribute to split the data (e.g., using information gain)
* Split the dataset into subsets based on attribute categories.
* Repeat this process recursively for each subset.
* Traverse the tree to predict new data points based on attribute decisions

Figure 3.5.4.1 Decision Tree

Formula:

Although there are other approaches to choosing the optimal attribute at each node, the Gini impurity and information gain methods are the two most frequently used as a splitting criterion in decision tree models. They aid in assessing the effectiveness of each test condition and its capacity to categorize samples into a group.

Entropy:

Where,

* S stands for the collection of data from which entropy is determined.
* The classes in the set are represented by c,
* S p(c) denotes the percentage of the set's total number of data points that are members of class c, S.

Information Gain:

Information Gain = entropy (parent) – [average entropy (children)]

Gini: The gini impurity is calculated by this formula-

Where, Pj is the probability of class j.

3.6 The background and rationale of design choice

K-Means is a clustering algorithm introduced by Stuart Lloyd in 1957 at Bell Telephone Laboratories. It's designed for grouping data points into clusters based on similarity, with the objective of minimizing the sum of squared distances between data points and their cluster centroids. Regional Origin: K-Means doesn't have a specific regional origin, as it's a mathematical algorithm widely used in data analysis and machine learning across the globe.

SVM was developed by Vladimir Vapnik and Alexey Chervonenkis in the 1960s, with significant advancements in the 1990s. Initially a binary linear classification algorithm, SVM has evolved into a versatile tool for both classification and regression tasks, emphasizing maximizing the margin between classes.

Regional Origin: The founders of SVM, Vladimir Vapnik and Alexey Chervonenkis, have backgrounds from the former Soviet Union (Russian and Ukrainian, respectively). However, SVM's use and influence extend globally in machine learning and data science.Decision trees have roots in statistics and computer science. They were formalized for decision-making by Morgan and Sonquist in 1963 and further developed, particularly by Leo Breiman and others, in the 1980s. Decision trees are used for classification and regression tasks, creating a tree-like structure of decisions to make predictions.

Regional Origin: Decision trees, as a concept, do not have a specific regional origin. They have been developed and improved by researchers and practitioners from various regions and are widely used in machine learning and data analysis globally. The Naive Bayes classifier is based on Bayes' theorem, which was developed by the English statistician Thomas Bayes in the 18th century. The "naive" part of Naive Bayes comes from the assumption of independence between features in the classification process, which simplifies calculations.

Regional Origin: Bayes' theorem, which forms the foundation of Naive Bayes, was developed by Thomas Bayes, an English mathematician. The algorithm itself is not tied to a specific region and is used worldwide for text classification, spam filtering, and more.

3.7 Requirements

Once we carefully examined all the essential statistical and theoretical concepts and techniques, we compiled a roster of the required hardware, software, and development tools necessary for forecasting career recommendations.

Hardware/Software Requirements:

* Operating System (Windows 7 or more)
* Ram (4 GB or more)
* Web Browser ( chrome or any suitable one)

Developing Tools

* Python 3.10 or latest version
* Anaconda
* Visual Studio code
* Jupiter notebook

**Chapter IV. Result and Discussion**

This chapter will cover the details of our research, including the experimental results. We will compare our algorithms to select the most effective one for prediction, and visualize the output using a confusion matrix. To conclude the chapter, we will summarize the results.

4.1 Experimental Results

We utilized more than 10000 simulated datasets from various fields of Computer Science and Engineering and crafted different questions to evaluate the recommended field of study for a student's future career and job. The dataset comprises ten diverse attributes covering several questions related to a student's personal life and interests. The output of this analysis is a recommendation of a student's field of study based on their interests and previous academic pursuits, specific to the Bangladeshi environment. Our output class for the system is a student's chosen discipline or field of study, with ten fields. We employed two machine learning models, namely Naïve Bayes and k-NN, Decision Tree and SVMt o analyze our datasets and generate recommendations. Although the initial results were unsatisfactory, a real-world dataset is expected to enhance the accuracy of the output.

4.2 Prediction of Results

The machine learning model's performance can be assessed using a confusion matrix, which is a table consisting of four values: true positive, true negative, false positive, and false negative. This technique can be applied to the test dataset, where the true values are already known. True positives (TP) are the values where the examples are accurately identified as positive. False positives (FP) are the values where the examples are negative, but they are mistakenly classified as positive. True negatives (TN) are the values where the examples are accurately identified as negative. Finally, false negatives (FN) are the values where the examples are positive, but they are incorrectly classified as negative.

Performance measures can be calculated using the following formulas:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Classification Model | Accuracy | Precision | Recall | F-measure |
| Decision Tree | 96.92 | 99.88 | 100.0 | 100.0 |
| SVM | 92.68 | 99.581 | 99.588 | 99.647 |
| Naïve Bayes | 89.84 | 99.82 | 99.88 | 99.94 |
| K-NN | 90.5 | 96.53 | 96.11 | 96.29 |

TABLE 4.2.1: PERFORMANCE MEASUREMENTS

Based on the table presented above, the Decision Tree Classifier algorithm has been identified as the most effective classifier for providing recommendations regarding suitable choice.

Figure 24.2.1 Accuracy of the Models

**FIGURE: 3.2.1 PROPOSED METHODOLOGY OF WO**

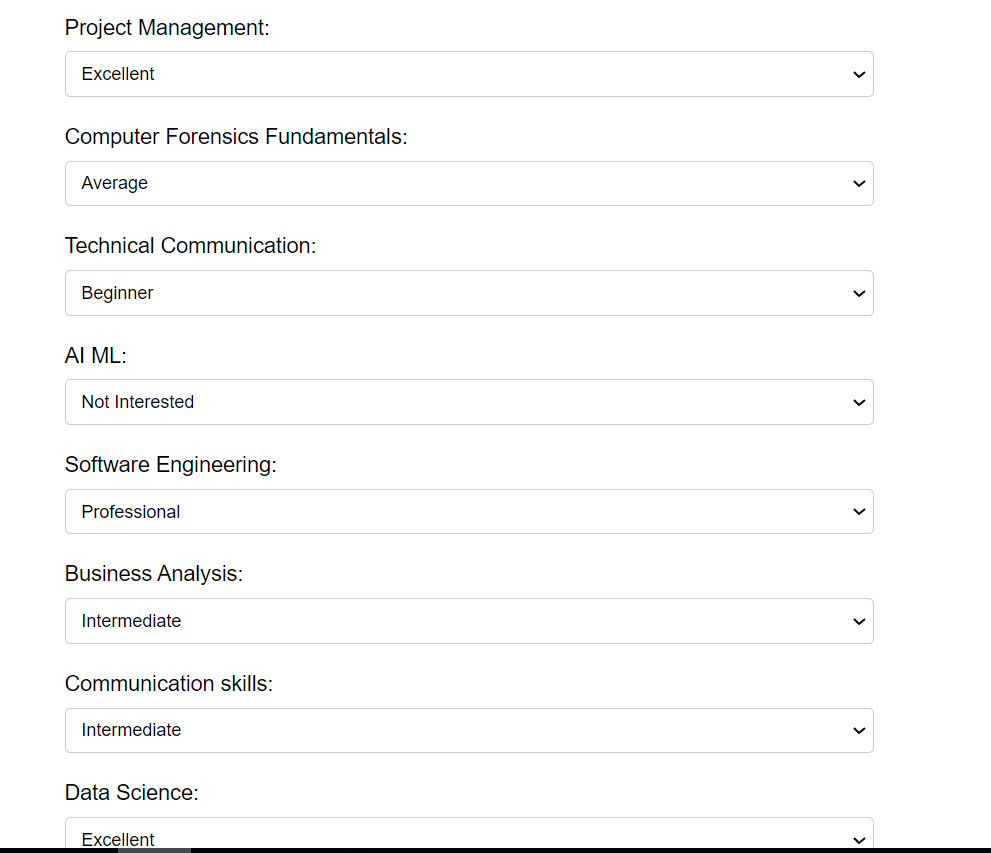
FIGURE: 4.2.1: Accuracy

F=-Measures values are mentioned below:

TABLE 4.2.2: F-MEASURE OF CATEGORY

|  |  |
| --- | --- |
| Categories | F-Measure |
| AI ML Specialist | 98.5 |
| API Specialist | 98.5 |
| Application Support Engineer | 100.0 |
| Business Analyst | 94.5 |
| Customer Service Executive | 95 |
| Cyber Security Specialist | 95 |
| Data Scientist | 96 |
| Database Administrator | 96 |
| Graphics Designer | 98 |
| Hardware Engineer | 99 |
| Helpdesk Engineer | 100 |
| Information Security Specialist | 98 |
| Networking Engineer | 97 |
| Project Manager | 97 |
| Software Developer | 98 |
| Software tester | 98 |
| Technical Writer | 98 |

#### 4.2.1 Input Snapshot:



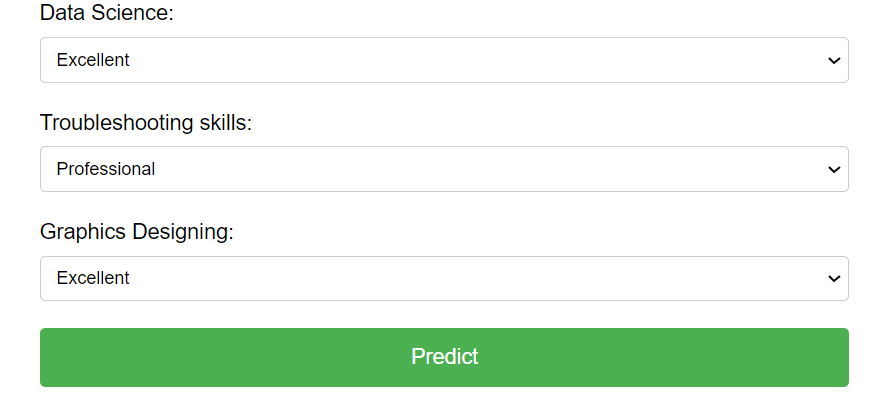


Figure 4.2.1.1 Input

#### 4.2.2 Output Snapshot

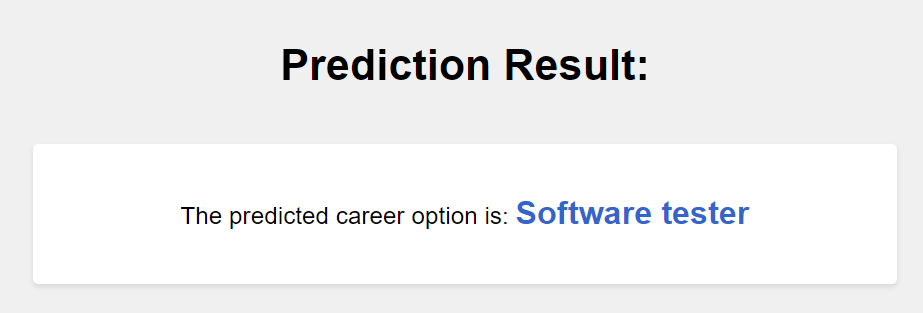


Figure 4.2.1.2 Output

#### 4.3 Significance of Research

The research on career guidance recommendation system holds significant importance in today's rapidly changing and competitive job market. With the increasing number of fields and specializations, it can be overwhelming for students to make the right career choice. A recommendation system based on machine learning algorithms can provide personalized career guidance to students, which can help them make informed decisions about their future. The significance of this research lies in its potential to benefit students, educational institutions, and industries. By providing students with personalized recommendations based on their interests and academic history, the system can assist them in selecting the most suitable career path. Educational institutions can also use this system to enhance their career guidance services and ensure that their students are well-equipped for the job market. Additionally, industries can benefit from a more skilled and specialized workforce, which can ultimately lead to economic growth. Moreover, this research can contribute to the development of machine learning algorithms and techniques, which can be applied to various other fields. It can also provide insights into the factors that influence career choices and help researchers and policymakers develop strategies to address issues related to unemployment and skill gaps. Overall, the research on career guidance recommendation systems can have a significant impact on the education and job sectors, the economy, and the advancement of machine learning techniques. It can ultimately benefit society as a whole by providing individuals with the guidance they need to succeed in their chosen careers.

4.4 Limitations

We are working with artificial datasets but real world datasets are better for prediction. If we use artificial datasets our prediction can be or results can be different. Our research is only for the fields of Computer Science and Engineering Departments. We have not covered other departments like CE, ME, EEE etc. Also we have not covered Medical and Business field.

4.5 Implementation for further study

There are several implications for further study that can be from our research:

* Data sets can cover the real world data sets and departments can be other engineering departments, Business and Medical fields.
* Since our research was conducted using dummy datasets, one important future direction would be to test our approach on real-world datasets to evaluate its effectiveness in practical settings.
* We can also consider adding more fields of study to our research work to provide a wider range of recommendations to students.
* Another potential avenue for further study is to deploy our research as an Android and website application to make it more accessible and user-friendly for students seeking career guidance.
* Lastly, we can explore the possibility of publishing a publication that details our research work to disseminate our findings to a wider audience and invite further discussion and collaboration in the field.

**Chapter V. Conclusion**

5.1 Conclusion

The career guidance recommendation system is designed for Bangladeshi students who struggle with choosing a subject for their graduation. By using machine learning models like Naïve Bayes, k-NN, and Fuzzy Logic, the system recommends a field of study based on a student's interests and previous academic pursuits. This research can assist students in selecting a field of study and can benefit industries that employ these students in the future. Furthermore, the system has the potential to be extended to other fields of study and deployed as a mobile application or website. This can greatly benefit students in making informed decisions about their career paths and help them achieve their desired career goals. The future work for this research includes using real-world datasets to further validate the accuracy of the system, adding more fields of study, and improving the system's user interface. Overall, the Career Guidance Recommendation System using Machine Learning can have a significant impact on improving the career guidance services provided to students, and help them make informed decisions about their future career paths.

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