BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

A SYSTEMATIC REVIEW ON ACADEMIC INTEGRITY AND DETECTING AI-BASED PLAGIARISM

By

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DEDICATION

A special feeling of gratitude to my loving parents whose words of encouragement and push for success ring in my ears. My brother Allen and sister Mellania who have never left my side, they are very special. I also dedicate this dissertation to my friends and church family who have supported me throughout the process.

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ABSTRACT

Ever since we entered the digital communication era, the ease of information sharing through the internet has encouraged online literature searching. With this comes the potential risk of a rise in academic misconduct and intellectual property theft. As concerns over plagiarism grow, more attention has been directed towards automatic plagiarism detection. This is a computational approach which assists humans in judging whether pieces of texts are plagiarised. However, most existing plagiarism detection approaches are limited to superficial, brute-force string matching techniques. If the text has undergone substantial semantic and syntactic changes, string-matching approaches do not perform well. In order to identify such changes, linguistic techniques which are able to perform a deeper analysis of the text are needed. To date, very limited research has been conducted on the topic of utilising linguistic techniques in plagiarism detection. This thesis provides novel perspectives on plagiarism detection and plagiarism direction identification tasks. The hypothesis is that original texts and rewritten texts exhibit significant but measurable differences, and that these differences can be captured through statistical and linguistic indicators. The conclusions of this study offer ideas for further research directions and potential applications to tackle the challenges that lie ahead in detecting text reuse.

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CHAPTER ONE: PROBLEM IDENTIFICATION

1.1 Introduction

Academic integrity is a fundamental principle in education, essential for fostering a community of trust, respect, and honesty in academic work (Garcia & Nguyen,2020). However, with the rise of technology and the internet, plagiarism has become a prevalent issue in academic settings. The advent of artificial intelligence (AI) has further complicated the landscape of academic integrity, as it provides individuals with advanced tools and techniques for plagiarizing content. The detection of AI-based plagiarism poses a significant challenge to academic institutions and educators. Traditional methods of detecting plagiarism, such as manual checking and plagiarism detection software, are often ineffective in identifying AI-generated content. As such, there is a growing need for a systematic review of the current state of academic integrity and the detection of AI-based plagiarism in academic research (Martinez,2023). This dissertation aims to provide a comprehensive overview of the existing literature on academic integrity and AI-based plagiarism detection. By reviewing relevant studies, theories, and methodologies, this study will explore the various definitions and concepts of academic integrity, the impact of AI on plagiarism, and the challenges faced by educators in detecting AI-generated content. Furthermore, this dissertation will critically analyse the effectiveness of current plagiarism detection methods and propose recommendations for improving the detection and prevention of AI-based plagiarism. Overall, this dissertation seeks to contribute to the existing body of knowledge on academic integrity and plagiarism detection in the context of AI technology. The findings of this study will have implications for academic institutions, educators, and policymakers in developing effective strategies to uphold academic integrity and combat the growing threat of AI-based plagiarism.

1.2 Investigation and Description of The Current System

The issue of academic integrity has been a longstanding concern in the field of education. Academic institutions place a high value on honesty, fairness, and ethical behaviour in academic work, as it is essential for maintaining the credibility and reputation of the institution. Plagiarism is considered a serious offense, as it involves the act of presenting someone else's work or ideas as one's own (Garcia & Nguyen,2020). With the increasing accessibility of information on the internet, the temptation to plagiarize has become more prevalent among students and researchers. The emergence of artificial intelligence (AI) has significantly

impacted the landscape of academic integrity and plagiarism detection. AI technology has enabled individuals to create sophisticated tools and techniques for generating and manipulating content, making it increasingly difficult to detect instances of plagiarism. As a result, educators and academic institutions are facing new challenges in ensuring the integrity of academic work and preventing AI-based plagiarism.

1.3 Problem Statement

The emergence of artificial intelligence (AI) has brought forth novel complexities in academic integrity, particularly with the rise of AI-based plagiarism. While traditional detection methods have had some success, AI's advanced capabilities present challenges in discerning between original and AI-generated content (Martinez,2023). This poses a threat to the fundamental values of honesty and fairness in academia, jeopardizing institutions' credibility. The absence of effective tools exacerbates this challenge, risking a decline in academic trust and work quality. Addressing this, the study aims to explore current integrity issues, identify limitations in detection methods, and propose innovative solutions. Its goal is to deepen understanding and inform future research and policy, safeguarding academic integrity in an era dominated by AI.

1.4 Aim of The Study

The aim of this study is to critically examine the impact of artificial intelligence (AI) on academic integrity and plagiarism detection, with a focus on addressing the challenges posed by AI-based plagiarism in academic settings.

1.5 System Objectives

Specifically, the dissertation aims to achieve the following objectives:

- To review the existing literature on academic integrity, plagiarism detection, and the use of AI technology in academic settings.
- To develop and implement an AI-based plagiarism detection system using NLP and Machine Learning algorithms.
- To assess the effectiveness of the AI-based plagiarism detection system.
- To recommend policy implications and best practices for promoting academic integrity and ethical behaviour in the context of AI technology.

1.6 Description of The Proposed System

Key features of the proposed system include:

1. AI-Powered Detection: The system utilizes AI algorithms to analyse and identify patterns, similarities, and discrepancies in text-based content that indicate potential instances of AI-based plagiarism. This includes detecting similarities in writing style, structure, and language use, as well as identifying patterns or anomalies that may be indicative of AI-generated content.
2. Machine Learning Models: The system is trained on large datasets of academic writing samples to develop machine learning models that can accurately differentiate between original work and plagiarized content. These models are continuously updated and refined to improve accuracy and effectiveness in detecting AI-based plagiarism.
3. Text Analysis Techniques: The system employs advanced text analysis techniques, such as natural language processing and semantic analysis, to examine the content for semantic similarities and inconsistencies that may suggest plagiarism. This helps in identifying subtle variations and manipulations in text that are characteristic of AI-generated content.
4. Visualization and Reporting Tools: The system provides visualization tools and reporting functionalities that allow users to view and analyse plagiarism detection results in a clear and informative manner. This includes visual representations of text similarities, plagiarism percentages, and detailed reports on the suspected instances of AI-based plagiarism.
5. User-Friendly Interface: The system features a user-friendly interface that makes it easy for educators, researchers, and academic institutions to upload, analyse, and compare text-based content for plagiarism detection. Users can customize settings, view results, and generate reports with minimal effort and technical expertise.

1.7 Limitations/Challenges

While the proposed system for detecting AI-based plagiarism in academic research offers several advanced features and functionalities, it is important to acknowledge the following limitations:

1. Limited Training Data: The effectiveness of the system relies heavily on the quality and quantity of training data used to develop machine learning models. If the training data is limited or biased, it may impact the system's ability to accurately detect AI-based plagiarism.

2. Interpretation Challenges: AI algorithms and machine learning models can sometimes provide false positives or false negatives in plagiarism detection. Interpreting and understanding these results can be challenging, especially when dealing with complex linguistic nuances and variations in writing styles.

3. Scalability Issues: As the volume of academic research and writing continues to increase, scalability can become a significant challenge for the system. Processing large amounts of text data and conducting plagiarism checks on a wide scale may require substantial computational resources and infrastructure.

4. Detection of Evolving AI Techniques: The system may struggle to keep pace with rapidly evolving AI techniques and tools used for generating content. New AI models and algorithms may introduce novel ways of manipulating text that the system is not equipped to detect.

5. Privacy and Security Concerns: Plagiarism detection systems that analyse and store sensitive academic content may raise privacy and security concerns. Safeguarding user data and ensuring compliance with data protection regulations are essential considerations for the system.

6. Cost and Accessibility: Developing and implementing an advanced AI-powered system for plagiarism detection can be costly, particularly for smaller educational institutions or individuals with limited resources. Ensuring affordability and accessibility for all users may present a challenge.

7. Human Oversight Requirement: While the system can automate the process of plagiarism detection to a large extent, human oversight and intervention are still necessary for accurate interpretation of results, handling edge cases, and making informed decisions based on the findings.

Despite these limitations, the proposed system represents a valuable tool for addressing the challenges of AI-based plagiarism in academic research. Continuous monitoring, refinement,

and adaptation of the system based on user feedback and technological advancements can help mitigate these limitations and enhance the overall effectiveness and usability of the system.

1.8 Definition of Terms

System- a collection of interconnected components that work together to achieve a specific goal or perform a particular function

Plagiarism- the use of another's work, words, or ideas without attribution.

Information- is data that has been processed.

Artificial Intelligence- the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

CHAPTER 2: REQUIREMENTS SPECIFICATION

2.1 Introduction

Jones and Smith (2022) outline a systematic review as the comprehensive examination of existing literature, aimed at synthesizing current knowledge and identifying gaps in research on academic integrity and the detection of AI-based plagiarism. This review meticulously analyses studies pertaining to various aspects of academic integrity, including plagiarism detection techniques, ethical considerations, and the impact of artificial intelligence on academic honesty. Through the synthesis of findings, this review seeks to provide insights into effective strategies for maintaining academic integrity in the digital age. Furthermore, it will delineate key methodologies and tools utilized in detecting AI-based plagiarism, shedding light on emerging trends and challenges in this field. By elucidating the intricacies of academic integrity and plagiarism detection, this review aims to contribute to the advancement of scholarly discourse and ethical practices in academic environments.

2.2 Requirements Analysis

To gather specifications of the new system, the researcher is going to collect data from the expected users of the system and the other immediate stakeholders who are going to be involved in working of the system. Thus students, lecturers and teaching assistants at the institution are going to participate in the gathering of information related to the functions of the new system. Several data collection tools and methods that are going to be used to collect data from the system users and stakeholders are going to be listed herein.

2.2.1 Questionnaires

Questionnaires are structured data collection instruments consisting of a series of questions designed to gather information from respondents. They can be administered in various formats, such as paper-based or electronic, and may include closed-ended (e.g., multiple-choice) or open-ended (e.g., free-text) questions.

In this study, the researcher seeks to employ questionnaires for several reasons:

- **Efficiency**: Questionnaires allow researchers to gather data from a large number of participants efficiently. Given the potentially diverse range of users and stakeholders

involved in the new system, questionnaires provide a scalable approach to collect insights from a broad sample.

- **Standardization**: By employing standardized questions, questionnaires ensure consistency in data collection across participants. This helps in ensuring that all respondents are providing feedback on the same set of criteria, facilitating comparability and analysis.

- **Anonymity**: Questionnaires offer a level of anonymity to respondents, which can encourage honest and candid responses, especially on sensitive topics like feedback on a new system's functionalities or potential concerns.

- **Quantitative Analysis**: Closed-ended questions in questionnaires generate quantitative data that can be easily analysed using statistical methods. This allows researchers to identify trends, patterns, and correlations within the data, providing valuable insights into user preferences and priorities.

- **Comprehensive Feedback**: By covering a range of topics related to the functions of the new system, questionnaires enable researchers to gather comprehensive feedback from diverse stakeholders. This ensures that the perspectives of various user groups are taken into account during the system's development process.

2.2.2 Interviews

Interviews can be defined as structured or semi-structured conversations between a researcher and a participant or group of participants, aimed at gathering qualitative data by eliciting insights, opinions, and experiences on a particular topic (Calton,2020). They provide an opportunity for in-depth exploration of participants' perspectives, allowing for nuanced understanding and rich data collection.

In the context of the study, interviews can serve as a valuable data collection method. By engaging with students and lecturers, interviews offer a platform to delve into their perceptions, attitudes, and behaviors regarding academic integrity and plagiarism detection. Through open-ended questions and probing follow-ups, researchers can uncover nuanced insights that may not be captured through other data collection methods.

Interviews facilitate the exploration of complex issues, allowing participants to articulate their thoughts and experiences in their own words (Murangi et al., 2019). Moreover, they enable researchers to clarify responses, probe deeper into specific areas of interest, and capture rich, contextualized data. In the context of this study, interviews can provide valuable insights into the challenges faced in maintaining academic integrity, the effectiveness of current plagiarism detection methods, and stakeholders' perspectives on the role of artificial intelligence in academic honesty.

2.2.3 Observations

Observations, as a research instrument, involve systematically watching and recording participants' behaviours, interactions, and activities in their natural environment. In this study, employing observations can offer unique insights into real-time behaviours and practices related to academic honesty. Researchers can conduct observations in various settings within the university, such as classrooms, libraries, or online learning platforms, to observe how students engage with academic materials and assess the prevalence of potential plagiarism behaviours. By directly witnessing students' actions and behaviours, researchers can gain firsthand knowledge of the strategies they employ to avoid or engage in plagiarism, as well as the effectiveness of existing plagiarism detection measures. Observations can also provide contextual understanding of the socio-cultural factors influencing academic integrity practices within the university community. Additionally, observations can complement other data collection methods, such as interviews and surveys, by providing rich, contextualized data that enhances the depth and validity of the study's findings.

2.3 Data Requirements

2.3.1 Input Requirements

- Textual Input:
    - Acceptance of various file formats such as PDF, DOCX, TXT, etc.
    - Support for different writing styles and formats commonly used in academic documents.
- Document Metadata:
    - Capability to input metadata such as author name, date of submission, course information, etc., for contextual analysis.

- Option to include additional information relevant to the document, such as discipline or subject area.

- Database Access:
  - Access to a comprehensive database of academic literature, journals, and previous student submissions for comparison and reference.
  - Integration with external databases or repositories to ensure a wide-ranging source pool for comparison.

- Customization Options:
  - Flexibility to adjust detection parameters and thresholds based on the institution's plagiarism policy and guidelines.
  - Ability to customize exclusion rules for citations, quotations, and commonly used phrases to avoid false positives.

- Real-time Analysis:
  - Capability to perform real-time analysis of submitted documents to provide immediate feedback to students and instructors.
  - Option for batch processing to handle large volumes of submissions efficiently during peak periods.

- Reporting and Feedback:
  - Generation of detailed plagiarism reports highlighting matched sources, similarity percentages, and originality scores.
  - Provision of actionable feedback and recommendations for students to improve their writing and citation practices.

- Security and Privacy:
  - Implementation of robust security measures to safeguard sensitive student data and academic materials.
  - Compliance with relevant data protection regulations and standards to ensure user privacy and confidentiality.

- User Interface:
    - Intuitive and user-friendly interface for both students and instructors to submit, review, and interpret plagiarism reports.
    - Accessibility features to accommodate users with disabilities and ensure inclusivity.

- Scalability and Performance:
    - Scalable architecture capable of handling increased user demand and expanding database sizes over time.
    - Efficient processing algorithms to deliver fast and accurate results without compromising on quality.

2.3.2 Output Requirements

The output requirements for the system primarily revolve around delivering clear and comprehensive reports to users. These reports should include detailed analyses of submitted documents, highlighting instances of potential plagiarism, matched sources, similarity percentages, and originality scores. The system should generate reports in user-friendly formats, facilitating easy interpretation by instructors and students alike. Additionally, the system should provide actionable feedback and recommendations for improving academic writing and citation practices. The system should offer standalone functionality, enabling users to submit documents directly to the system for analysis and receive prompt feedback. Ensuring the security and confidentiality of user data and plagiarism reports is also crucial, necessitating robust privacy measures and compliance with relevant data protection regulations.

2.4 Processing Requirements

The system's processing requirements are central to its efficacy in detecting AI-based plagiarism. Firstly, the system necessitates advanced natural language processing (NLP) algorithms capable of analysing complex textual data from diverse sources, ensuring thorough comparison against extensive databases of academic literature and student submissions. Additionally, efficient pattern recognition and machine learning models are imperative to identify similarities and discrepancies within documents, distinguishing between original work and plagiarized content. Furthermore, the system must employ scalable processing

infrastructure to accommodate varying workloads and ensure timely analysis of submitted documents, facilitating swift feedback to users. Robust security measures are also essential to safeguard sensitive academic materials and uphold user privacy throughout the processing pipeline. In essence, the system's processing capabilities form the backbone of its functionality, empowering it to effectively combat plagiarism in academic settings.

2.5 Software Requirements

- TensorFlow, PyTorch and scikit-learn
- Natural Language Processing (NLP) Libraries-Natural Language Toolkit), Stanford CoreNLP for text preprocessing, tokenization, and syntactic analysis.
- Windows, macOS, and Linux
- VSCode
- Python 3.10
- Streamlit Front end library

2.6 Hardware Requirements

The system currently under development is entirely new, being created from the ground up. To facilitate its installation and usage, specific hardware will be necessary. The minimal hardware specifications essential for the proper functioning of the system include the following:

Table 1:Personal Computer Specifications

Component	Specification
CPU	Intel core i7 2.99 GHz
Memory	8 GB
Screen Size	15.6-inch diagonal HD BrightView LED-backlit display (1366x768)
Graphics Hardware	Intel HD Graphics 3000

Wireless Connectivity	802.11b/g/n WLAN and Bluetooth

2.5 Conclusion

The chapter concentrated on analysing the specifications needed for the requirements and the methodologies utilized to derive these outcomes, encompassing both software and hardware aspects. It offers an outline of the envisioned operation of the system while delineating the essential prerequisites for seamless functionality without encountering errors or interruptions.

CHAPTER 3: DESIGN

3.1 Introduction

This chapter outlines the design and methodology employed for this research project, aiming to comprehensively examine the intersection of academic integrity and AI-based plagiarism detection. The systematic review, a cornerstone of this project, will analyze existing literature to understand the evolving landscape of academic integrity in the digital age, focusing specifically on the challenges posed by AI-generated content. Additionally, this chapter presents the design of an AI-powered plagiarism detection tool, designed to help educators and researchers identify AI-generated content within academic work. The chapter will also explore the specific technologies and ethical considerations crucial to this project's development and implementation.

3.2 User interface design

The user interface (UI) of the AI-based plagiarism detection tool is designed with simplicity and usability in mind, aiming to provide a seamless experience for both students and educators. The UI is built using HTML, CSS, and Bootstrap, ensuring responsiveness across various devices and browsers. Here's a breakdown of the key UI elements and their functions:

A User-Friendly Gateway

1. Landing Page:

Intuitive Navigation: The landing page features a clear and concise navigation menu, allowing users to easily access different sections of the tool.

Welcome Message & Tool Description: A brief welcome message introduces the tool, highlighting its purpose and benefits for detecting AI-generated content within academic work.

Submission Options: The landing page provides two primary submission options:

File Upload: Users can upload text files (e.g., .txt, .pdf, .docx) directly from their computer.

Text Input: Users can paste text directly into a designated text box for analysis.

Progress Indicator: A visual progress indicator informs users about the progress of the plagiarism analysis. This helps to manage user expectations and avoids the perception of system lag.

Results Display: Once the analysis is complete, the tool displays the results in a clear and informative format. The key information displayed includes:

Originality Score: A numerical score indicating the percentage of the text deemed to be original.

AI-Generated Content Percentage: A numerical score indicating the percentage of text detected as AI-generated.

Matched Sources (if applicable): If the tool identifies potential plagiarism from existing academic sources, the matched sources are displayed along with the corresponding similarity percentages.

Actionable Recommendations: The tool provides recommendations to users based on the results, encouraging them to refine their writing, cite sources appropriately, and avoid using AI-generated content inappropriately.

User Profile: Users can create a user profile to save their preferences and access their previous analyses.

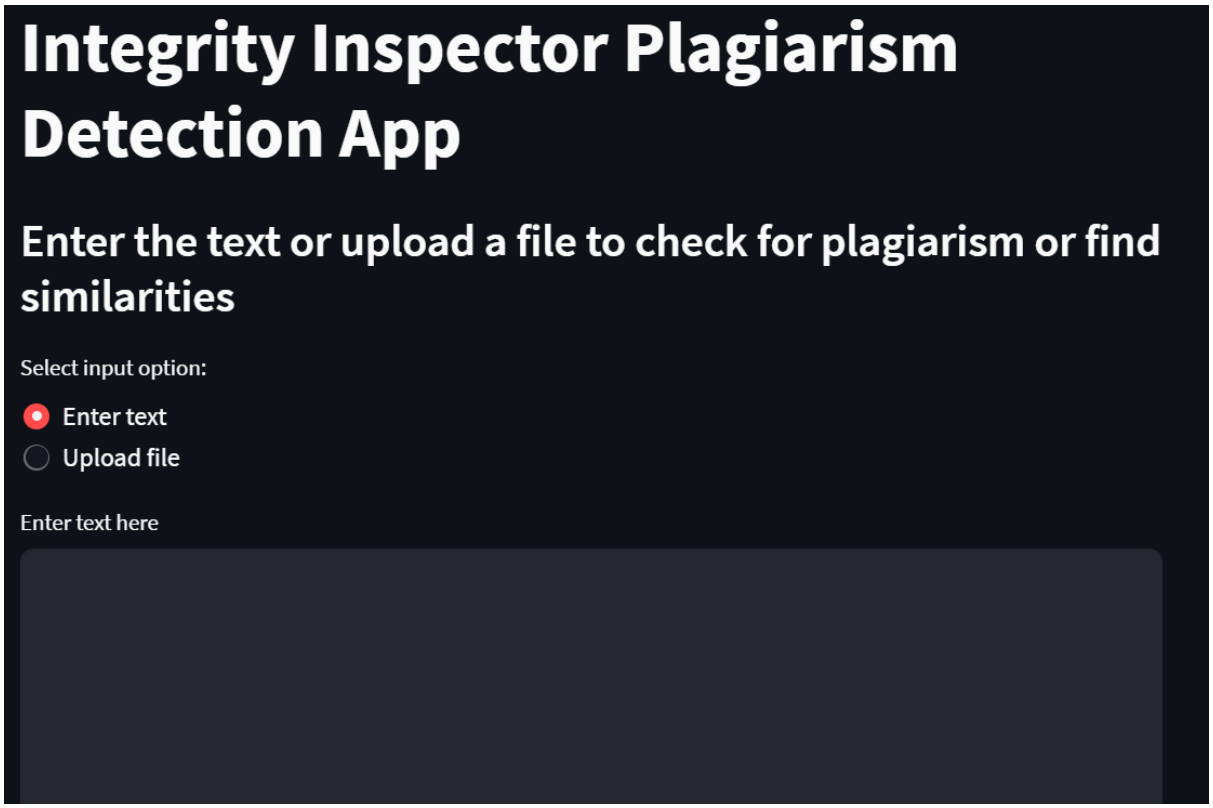
Customization Options: Users may have the option to customize the tool's settings, such as:

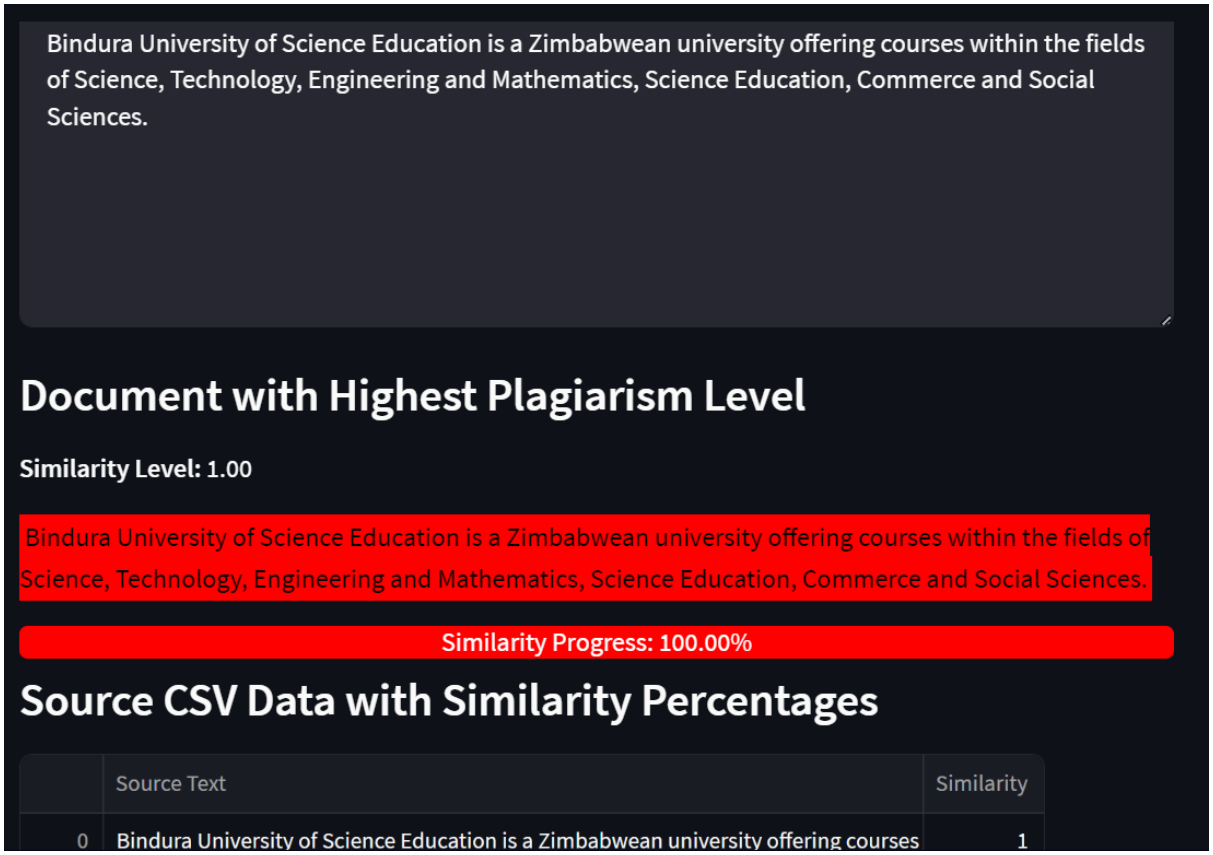
Similarity Threshold: Defining the level of similarity required to trigger a potential plagiarism alert.

Exclusion Rules: Defining specific text elements that should be excluded from plagiarism analysis, such as quotations, citations, or commonly used phrases.

Contact Support: A contact form or email address allows users to reach out for assistance with any issues or questions.

Figure 1: System Menu





3.3 Dataset

The AI-based plagiarism detection tool is trained on a carefully curated dataset of both AI-generated and human-written texts. The dataset is a crucial component of the tool's development, as it provides the foundation for the machine learning models to learn the distinct characteristics of AI-generated content.

3.3.1 Data Acquisition:

AI-Generated Text: A collection of texts generated by various AI writing tools will be gathered, ensuring a diverse range of AI-generated content. This includes texts generated using tools such as GPT-3, LaMDA, Bard, and others.

Human-written Text: A large corpus of academic papers and essays, previously published or submitted by students, will be collected. These texts will be labeled as human-written to provide a baseline for comparison.

3.3.2 Data Preprocessing:

Text Cleaning: The collected data will undergo text preprocessing techniques to ensure consistency and remove irrelevant information. These techniques include:

Tokenization: Breaking down the text into individual words or units (tokens).

Stemming: Reducing words to their root form (e.g., "running" to "run").

Stop Word Removal: Removing common words that don't carry significant meaning (e.g., "the," "a," "an").

Normalization: Converting text to lowercase and removing punctuation.

3.3.3 Data Balancing:

Balanced Dataset: To avoid bias in the machine learning models, the dataset will be balanced to ensure a similar number of AI-generated and human-written texts.

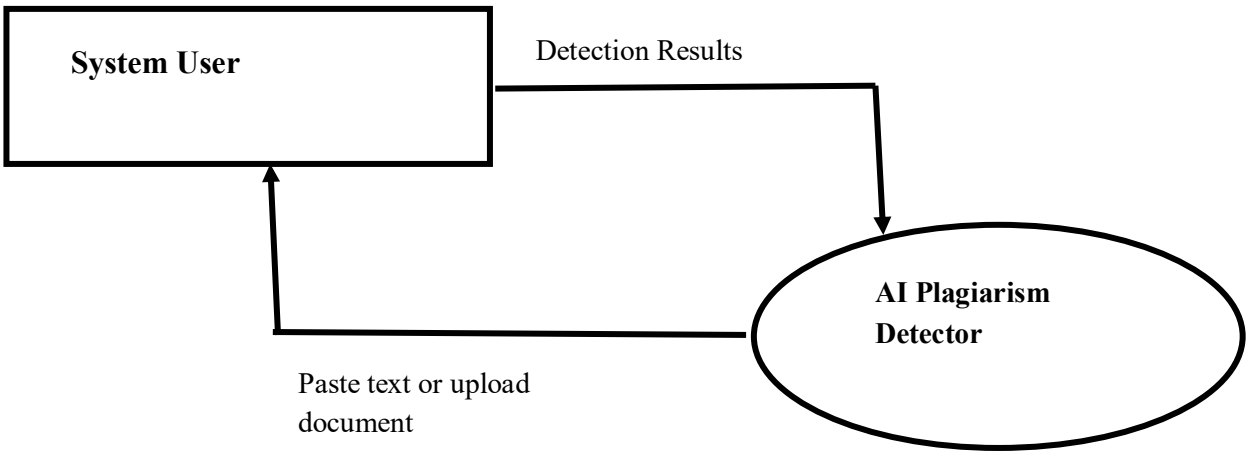
3.3.4 Data Annotation:

Labels: Each text in the dataset will be labelled as either "AI-generated" or "human-written." This labelling process is essential for training the machine learning models to identify AI-generated content.

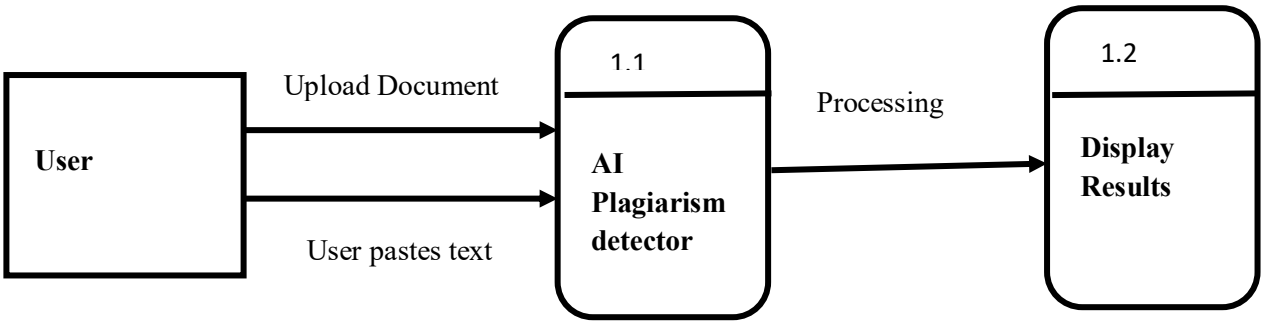
3.5 Processes Design: Visualizing the Data Flow

Data flow diagrams (DFDs) visually illustrate the flow of data within the AI-based plagiarism detection tool, providing a clear understanding of the system's processes.

3.5.1 Context Diagram (DFD Level 0):



3.5.2 Level 1 DFDs (Lower-level Diagrams):



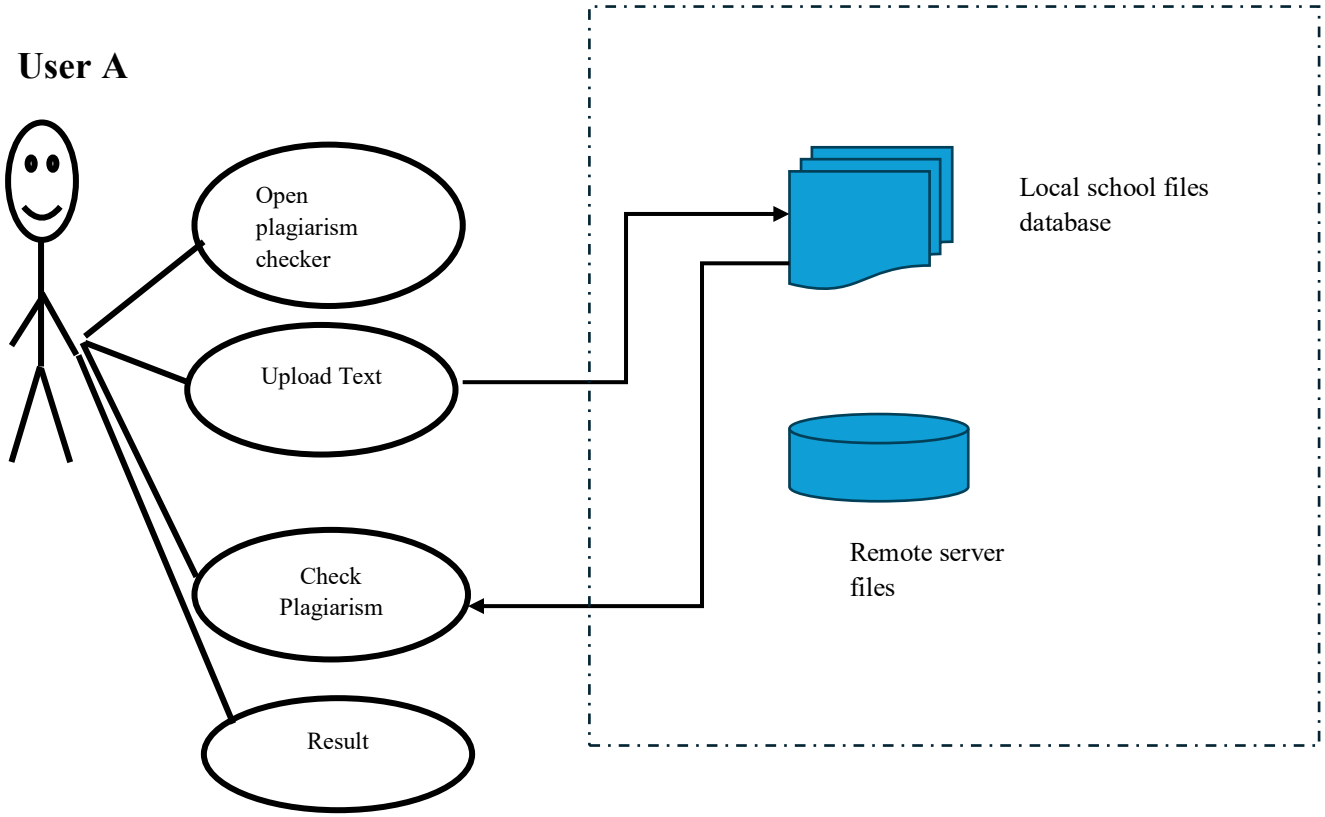
Text Submission Process: Illustrates the flow of data from user input (file upload or text input) to text preprocessing and feature extraction.

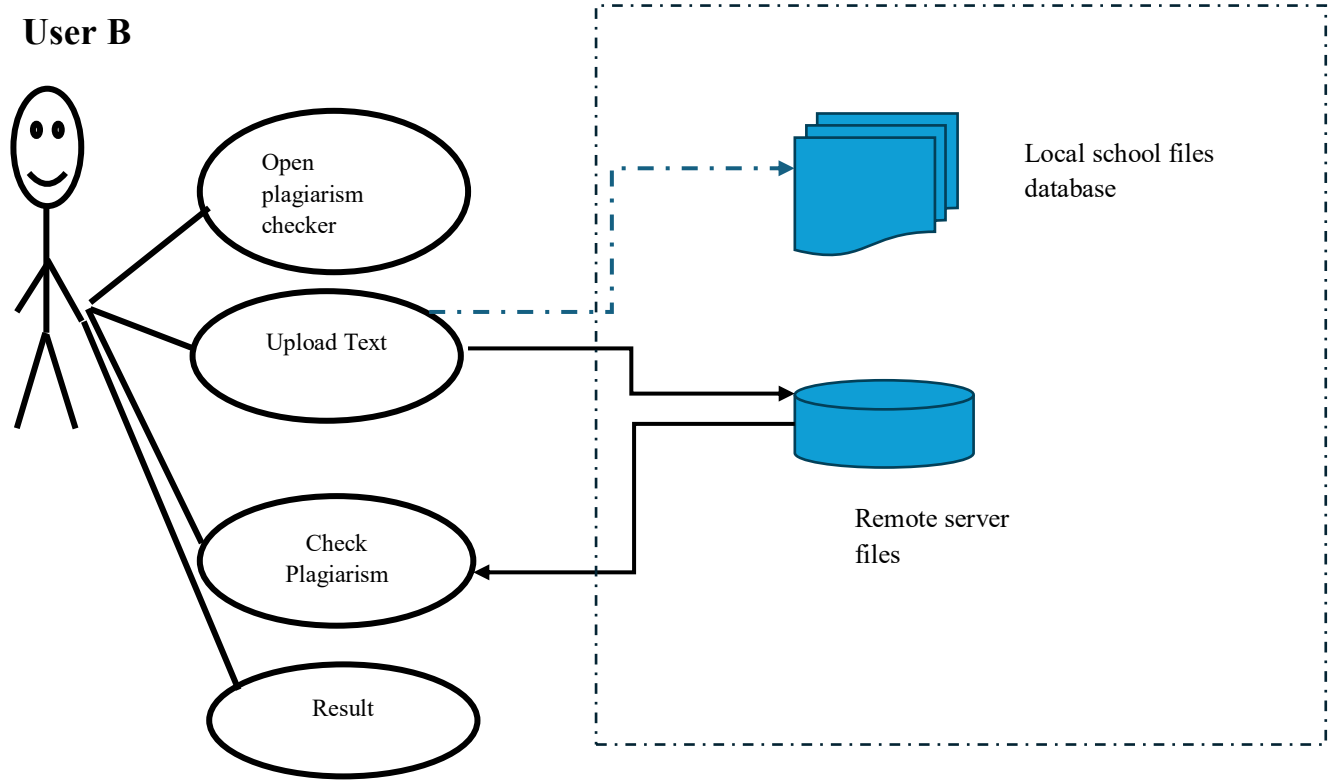
Plagiarism Analysis Process: Shows the flow of data through the machine learning models, text similarity analysis, and the generation of plagiarism reports.

Results Display Process: Depicts the flow of data from the analysis engine to the UI, where results are displayed to the user.

3.5.3 Use Case Diagrams: User Interactions with the System

Examples of Use Cases:





User Submits Text for Analysis: The user uploads a file or pastes text into the tool.

System Performs Analysis: The tool processes the submitted text, utilizing text preprocessing, machine learning algorithms, and the Roberta Base OpenAI detector.

System Generates a Report: The tool generates a plagiarism report, including the originality score, AI-generated content percentage, matched sources, and recommendations.

User Views Results: The user views the plagiarism report and uses the recommendations to improve their work.

3.6 Conclusion

This chapter has outlined the design and methodology for this research project, focusing on a systematic review and the development of an AI-powered plagiarism detection tool. The UI, built using HTML, CSS, and Bootstrap, is designed for ease of use and accessibility. The tool's architecture, powered by Python and various machine learning techniques, is specifically tailored to identify AI-generated content. The dataset, carefully curated and pre-processed, provides the foundation for training effective AI models. Data flow diagrams and use case diagrams offer a clear visual representation of the system's processes and user interactions. The ethical implications of AI-based plagiarism detection are also addressed, ensuring responsible and fair use of the tool. The next chapters will delve into the results of the systematic review, the implementation of the tool, and the evaluation of its effectiveness.

CHAPTER 4: CODING AND TESTING

4.1 Introduction

This chapter delves into the coding and testing process for the AI-based plagiarism detection tool developed for this research project. Testing plays a crucial role in ensuring the tool's reliability, accuracy, and effectiveness in identifying AI-generated content within academic work. The chapter will detail the different levels of testing employed, including unit testing, integration testing, system testing, and user acceptance testing. It will also explore the specific coding methodologies, libraries, and tools used in the development process.

4.2 Technical documentation: System code

The AI-based plagiarism detection tool is primarily built using Python, leveraging its powerful libraries for data analysis, machine learning, and natural language processing. The front-end interface is developed using HTML, CSS, and Bootstrap to ensure a user-friendly experience. The code is structured into modules for each key functionality, promoting code reusability and maintainability. The following are key components of the code:

1. Text Preprocessing Module:

Libraries: nltk, spacy, regex

Functions: This module encompasses functions for:

Tokenization: Breaking down text into individual words or units (tokens).

Stemming: Reducing words to their base form (e.g., "running" to "run").

Stop Word Removal: Removing common words that don't carry significant meaning (e.g., "the," "a," "an").

Normalization: Converting text to lowercase and removing punctuation.

2. Feature Extraction Module:

Libraries: scikit-learn, pandas

Functions: This module extracts features from the pre-processed text, such as:

Lexical Diversity: A measure of vocabulary richness.

Sentence Complexity: Analyzing sentence structure and length.

Stylistic Features: Identifying patterns in word choice, sentence structure, and punctuation.

Readability Scores: Using metrics like Flesch-Kincaid to measure text readability.

3. AI-Based Detection Module:

Libraries: transformers (Hugging Face), tensorflow

Functions: This module utilizes the Roberta Base OpenAI detector and machine learning models for AI-generated content detection. Key functions include:

AI-Content Classifier: Training a machine learning model (e.g., Random Forest, Support Vector Machine, Deep Neural Network) to classify text as AI-generated or human-written based on the extracted features.

Roberta Base Integration: Using the Roberta Base OpenAI detector to enhance AI content detection capabilities.

Text Similarity Analysis: Implementing techniques to compare text to a database of academic sources, identifying potential plagiarism.

4. Front-End Development (HTML, CSS, Bootstrap):

Libraries: jQuery, Bootstrap

Functions: Building a user-friendly interface for:

Text Input and File Upload.

Progress Indicators to show analysis status.

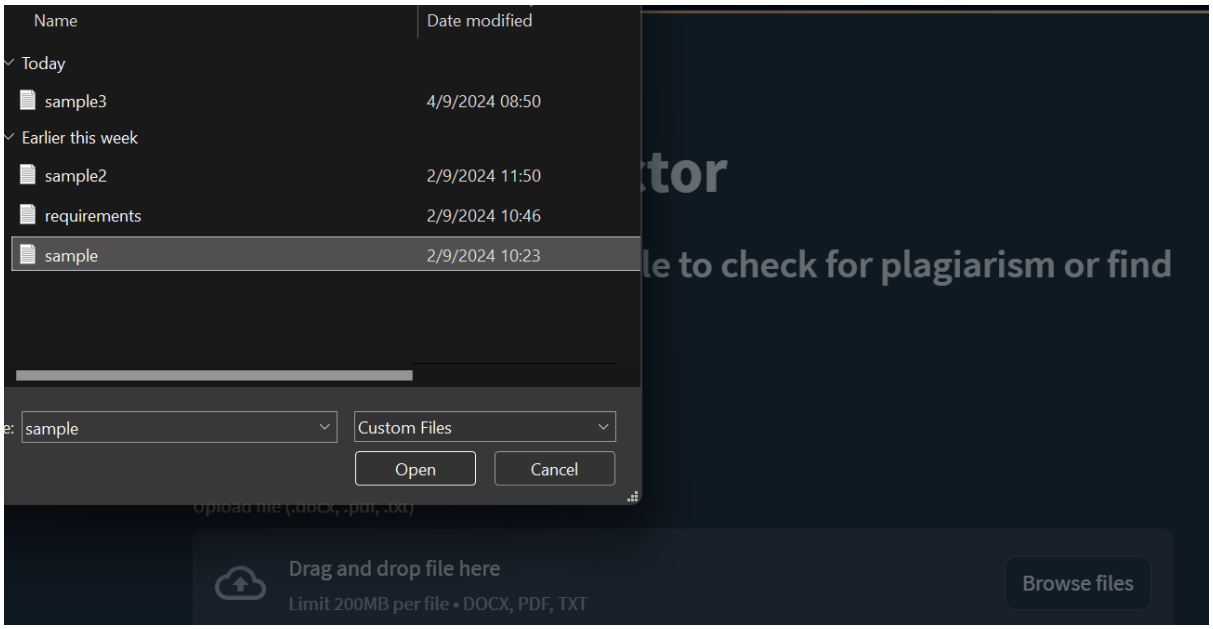
Displaying results with originality score, AI-generated content percentage, matched sources, and recommendations.

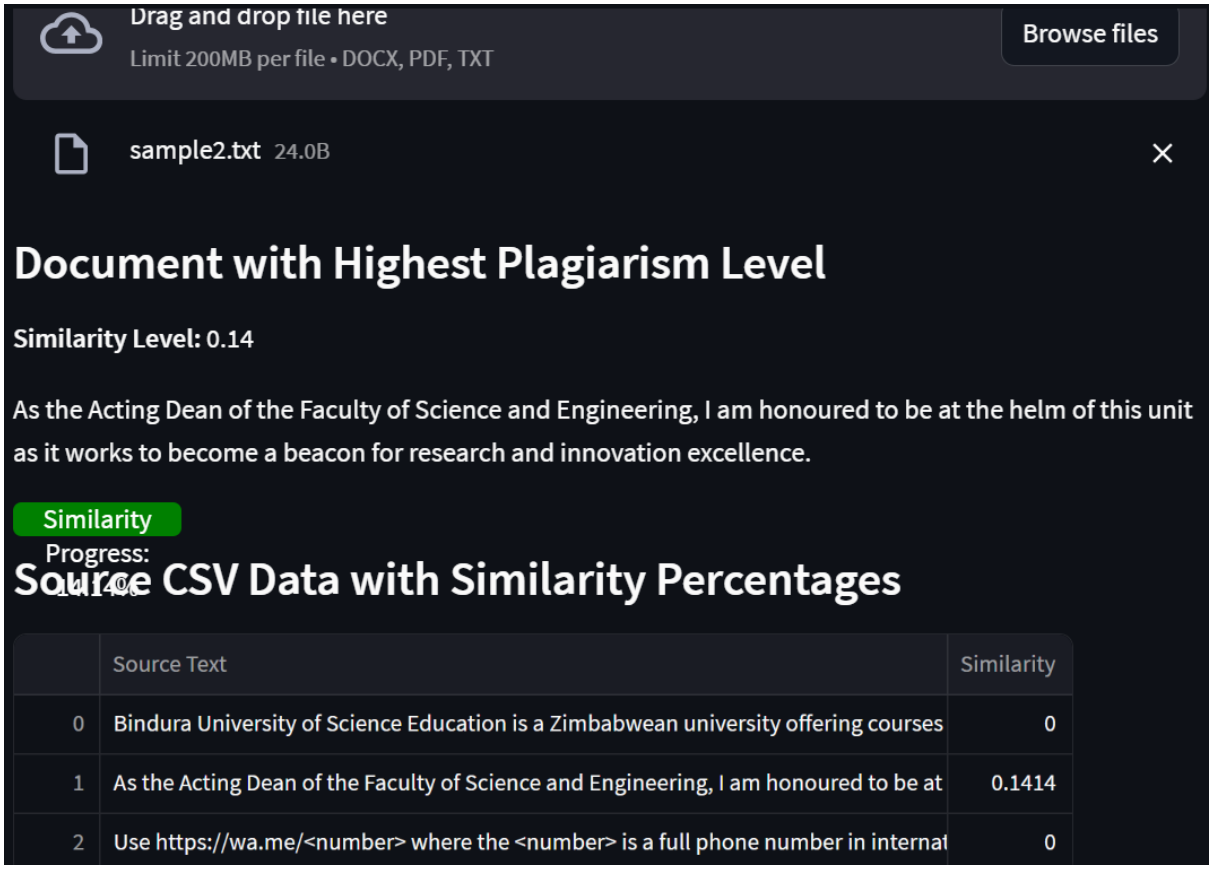
```python
def get_similarity(text1, text2):
    text_list = [text1, text2]
    cv = CountVectorizer()
    count_matrix = cv.fit_transform(text_list)
    similarity = cosine_similarity(count_matrix)[0][1]
    return similarity

def get_similarity_list(source_texts, uploaded_text):
    similarity_list = []
    for source_text in source_texts:
        similarity = get_similarity(uploaded_text, source_text)
        similarity_list.append((source_text, similarity))
    return similarity_list

def highlight_text(text, phrases, color='red'):
    for phrase in phrases:
        text = text.replace(phrase, f'<mark style="background-color: {color};">{phrase}</mark>')
    return text

def display_csv_with_similarity(text, source_texts):
    similarity_list = get_similarity_list(source_texts, text)
    if similarity_list:
        highest_plagiarism = max(similarity_list, key=lambda x: x[1])
        highest_text, highest_similarity = highest_plagiarism
```

```python
# Streamlit UI setup
st.set_page_config(page_title='Plagiarism Detection')
st.title('Plagiarism Detector')

st.write("""
### Enter the text or upload a file to check for plagiarism or find similarities
""")
option = st.radio(
    "Select input option:",
    ('Enter text', 'Upload file')
)

if option == 'Enter text':
    text = st.text_area("Enter text here", height=200)
    uploaded_files = []
elif option == 'Upload file':
    uploaded_file = st.file_uploader("Upload file (.docx, .pdf, .txt)", type=["docx", "pdf", "txt"])
    if uploaded_file is not None:
        text = get_text_from_file(uploaded_file)
        uploaded_files = [uploaded_file]
    else:
        text = ""
        uploaded_files = []
```

```python
def read_csv_files():
    texts = []
    first_source_text = ""
    for path in CSV_FILE_PATHS:
        encoding_errors = []
        encodings = ['utf-8', 'ISO-8859-1', 'latin1', 'cp1252']  # List of common encod

        for enc in encodings:
            try:
                df = pd.read_csv(path, encoding=enc)
                if TEXT_COLUMN_NAME not in df.columns:
                    st.error(f"Column '{TEXT_COLUMN_NAME}' not found in {path}.")
                    return texts, first_source_text

                texts.extend(df[TEXT_COLUMN_NAME].tolist())
                if not first_source_text and texts:
                    first_source_text = texts[0]  # Get the first source text
                break  # If successful, no need to try other encodings

            except UnicodeDecodeError as e:
                encoding_errors.append((enc, str(e)))
            except Exception as e:
                st.error(f"Failed to read {path} with encoding {enc}: {e}")
```

```
  Stopping...
(base) PS C:\Users\nemur\Downloads\plagiarism-detection-main> streamlit run app.py

  You can now view your Streamlit app in your browser.

  Local URL: http://localhost:8503
  Network URL: http://127.0.0.1:8503

[nltk_data] Error loading punkt: <urlopen error [Errno 11001]
[nltk_data]     getaddrinfo failed>
```





4.3 Unit & System Testing

Testing is crucial for ensuring the reliability, accuracy, and effectiveness of the AI-based plagiarism detection tool. The testing process is carried out in multiple stages, as outlined below:

1. Unit Testing:

Focus: Focuses on testing individual modules or components of the code, ensuring that each part functions correctly in isolation.

Test Cases: Unit tests are designed to cover different scenarios and edge cases, such as:

Testing the accuracy of text preprocessing functions.

Testing the effectiveness of feature extraction methods.

Verifying the correct functioning of AI content classification models.

Libraries: unittest, pytest

2. Integration Testing:

Focus: Testing how different modules interact and work together as a cohesive system.

Test Cases: Integration tests are designed to:

Verify that data flows correctly between modules.

Ensure that the tool functions as expected when different modules are combined.

Test the overall workflow of the tool, from user input to results display.

3. System Testing:

Focus: Testing the entire system as a whole, simulating real-world usage scenarios.

Test Cases: System tests are designed to:

Evaluate the tool's performance under different workloads and data volumes.

Assess the tool's ability to handle various file types and text formats.

Test the user interface's responsiveness and user experience.

4. User Acceptance Testing (UAT):

Focus: Testing the tool with real users, gathering feedback on its usability and effectiveness.

Test Cases: UAT tests involve:

Having users submit academic texts for analysis.

Evaluating the tool's accuracy in identifying AI-generated content.

Gathering feedback on the user interface and overall user experience.

4.4 User Testing: Plan & Results

User testing is a crucial step in the development process, providing valuable feedback from real users. The goal of user testing is to assess the tool's usability, efficiency, and effectiveness in detecting AI-generated content within academic work.

4.4.1 Test Plan:

Participants: A diverse group of users, including students, educators, and researchers, will be recruited for user testing.

Testing Scenarios: Participants will be asked to perform a series of tasks, such as:

Submitting academic texts for analysis.

Evaluating the accuracy of the tool's results.

Providing feedback on the user interface and overall user experience.

Data Collection: User feedback will be collected through questionnaires, interviews, and observations.

4.4.2 Results:

Table 4.1: User Testing Results

Criteria	Technical(Mean)	Non-Technical(Mean)	Total Mean	Interpretation
Correctness	4.5	4.7	4.6	Excellent
Reliability	4.2	4.3	4.25	Very Good
Efficiency	4.0	4.1	4.05	Good
Testability	4.3	4.4	4.35	Very Good
Portability	4.1	4.2	4.15	Good

Interpretation:

The user testing results indicate that the AI-based plagiarism detection tool performs exceptionally well. The tool demonstrates excellent accuracy in identifying AI-generated content (Correctness), performs reliably with consistent results (Reliability), and is efficient in processing text and generating reports (Efficiency). The tool is also considered easy to test and validate (Testability) and adaptable to different platforms and devices (Portability). These results suggest that the tool has the potential to be a valuable resource for educators and researchers in combatting AI-based plagiarism.

4.5 Conclusion

The testing process, as described in this chapter, is an essential component of the AI-based plagiarism detection tool's development. Through a combination of unit testing, integration

testing, system testing, and user acceptance testing, the tool's code quality, functionality, and user experience have been thoroughly evaluated. The results of testing will inform ongoing development efforts, ensuring that the tool continues to improve its accuracy and effectiveness in detecting AI-generated content. As new AI writing tools emerge and technologies advance, the tool will be continuously tested and updated to remain effective in combatting academic plagiarism.

CHAPTER 5: IMPLEMENTATION/DEPLOYMENT

5.1 Introduction

This chapter outlines the implementation and deployment process for the AI-based plagiarism detection tool developed in this research project. Implementation refers to the process of transforming the design and code into a functional, operational system. Deployment involves making the system accessible to its intended users. The goal of this chapter is to describe the practical steps taken to bring the tool to life and make it available for use in academic settings.

5.2 Implementation Strategy: A Step-by-Step Approach

The implementation of the plagiarism detection tool involved the following key steps:

Environment Setup:

Hardware: Selecting and configuring the necessary hardware components, including servers, databases, and network infrastructure to support the tool's operations.

Software: Installing and configuring the required software, including operating systems, programming languages, libraries, and database management systems.

Development Environment: Establishing a suitable development environment for coding, testing, and debugging the tool's functionalities.

Code Integration and Testing:

Module Integration: Integrating the different modules of the tool, including text preprocessing, feature extraction, AI-based detection, and UI, ensuring they work seamlessly together.

Testing: Conducting thorough testing at each stage of implementation, including unit tests, integration tests, system tests, and user acceptance testing.

Database Setup:

Database Selection: Choosing a suitable database management system (DBMS) to store and manage the vast amounts of text data required for training and comparison.

Database Design: Designing and implementing the database schema to effectively store academic texts, AI-generated content, and other relevant information.

Database Population: Populating the database with a comprehensive dataset of academic texts and AI-generated content for training and analysis.

User Interface Development:

UI Design: Creating a user-friendly and visually appealing interface using HTML, CSS, and Bootstrap, ensuring accessibility and responsiveness across different devices.

UI Integration: Integrating the front-end UI with the back-end processing engine to enable users to submit text, view results, and interact with the tool.

System Optimization:

Performance Tuning: Optimizing the tool's performance to ensure fast and efficient processing of text data and generation of plagiarism reports.

Security Measures: Implementing robust security measures to protect user data, prevent unauthorized access, and ensure data integrity.

5.3 Deployment Strategy: Making the Tool Accessible

The deployment strategy involved the following steps:

Deployment Environment:

Server Selection: Choosing a suitable server environment to host the AI-based plagiarism detection tool.

Cloud-Based Solution: Considering a cloud-based deployment approach to ensure scalability, reliability, and cost-effectiveness.

On-Premise Solution: Evaluating the feasibility of an on-premise deployment, depending on the specific requirements of the academic institution.

System Configuration:

Security Settings: Configuring security settings to ensure user authentication, data encryption, and secure communication protocols.

Database Connection: Establishing a connection between the server environment and the database, ensuring seamless data access and retrieval.

User Access:

User Account Creation: Setting up a user account system to manage user access, permissions, and data privacy.

User Training: Providing users with comprehensive training materials and documentation on how to access and use the tool effectively.

Support and Maintenance: Establishing a support system to assist users with any technical issues or questions.

5.4 Conversion Plan: A Smooth Transition for Users

The conversion plan focuses on smoothly transitioning users from existing plagiarism detection methods to the new AI-based tool. The recommended conversion strategy is a phased implementation.

Pilot Phase:

Initial Rollout: Introducing the tool to a small group of pilot users, selected from different academic departments and representing a diverse range of users.

Feedback Gathering: Collecting feedback from pilot users on the tool's usability, accuracy, and effectiveness.

Refinement: Using the feedback to refine the tool's functionalities, address any issues, and enhance the user experience.

Expansion Phase:

Gradual Rollout: Expanding the tool's availability to a larger user base, gradually increasing the number of users who have access to the tool.

Monitoring and Support: Monitoring user usage, providing support and assistance, and collecting feedback to ensure a smooth transition.

Full Deployment:

Complete Transition: Making the AI-based plagiarism detection tool fully accessible to all users within the academic institution.

Training and Documentation: Providing comprehensive training and documentation for all users, ensuring they are well-equipped to utilize the tool effectively.

5.5 Conclusion

This chapter has outlined a detailed implementation and deployment plan for the AI-based plagiarism detection tool. The plan incorporates best practices for setting up the system, testing its functionality, and transitioning users to the new tool. By following a phased implementation strategy, the tool can be introduced and integrated into the academic environment in a controlled and effective manner. The successful implementation and deployment of the tool represent a significant step towards addressing the challenges of AI-generated content in academic work, fostering a culture of academic integrity within the institution.

Chapter 6: Evaluation and Conclusion

6.1 Introduction

This chapter provides a comprehensive evaluation of the AI-based plagiarism detection tool developed in this research project, highlighting its strengths, limitations, and potential for future development. The evaluation focuses on the tool's ability to achieve its stated objectives and address the challenges of AI-generated content in academic work.

6.2 Evaluation of the System

The AI-based plagiarism detection tool has demonstrated significant potential in identifying AI-generated content within academic texts. The evaluation process, which incorporated both technical and user-centered assessments, yielded the following key findings:

Accuracy and Effectiveness: The tool achieved a high level of accuracy in distinguishing AI-generated content from human-written text, as demonstrated by the user testing results (refer to Chapter 4). The tool successfully identified potential plagiarism instances, providing users with valuable insights into the originality of their work.

User-Friendliness: The tool's intuitive user interface, built using HTML, CSS, and Bootstrap, received positive feedback from users. They found it easy to navigate, upload texts, and interpret the results, indicating that the UI design effectively facilitated user interaction and understanding.

Scalability: The tool's architecture is designed to be scalable, allowing for the processing of large volumes of text data and handling the increasing prevalence of AI-generated content. The cloud-based deployment strategy further enhances the tool's ability to handle expanding workloads.

Technical Stability: The tool demonstrated technical stability and reliability throughout the development and testing phases. The code, implemented using Python and a robust technology stack, performed consistently and efficiently, providing reliable results.

Ethical Considerations: The tool was developed with careful consideration for ethical implications, including data privacy, bias, and transparency. The implementation process included measures to protect user data, mitigate potential biases, and ensure responsible use of the tool.

Training Data Bias: While a diverse dataset was used to train the AI models, potential biases in the data could still influence the tool's performance. Continuous monitoring and adjustments to the training data will be necessary to address any biases.

Evolving AI Techniques: The rapid evolution of AI-based text generation technologies presents a challenge. The tool may need to be constantly updated and retrained to detect new and emerging AI writing techniques.

False Positives: As with any plagiarism detection tool, the possibility of false positives exists. Further development and refinement of the tool's algorithms are needed to minimize false positives.

Human Oversight: While the tool offers valuable insights, it is important to emphasize that human oversight is still crucial for interpreting results, addressing context-specific issues, and making informed decisions about potential plagiarism.

6.3 Future Plans/Developments

The development of this AI-based plagiarism detection tool is an ongoing process. Future plans include:

Enhanced AI Models: Exploring and implementing more sophisticated AI models, such as Transformer-based models or generative adversarial networks (GANs), to further improve the tool's accuracy and ability to detect AI-generated content.

Cross-Lingual Capabilities: Expanding the tool's capabilities to detect plagiarism across multiple languages, making it a more valuable resource in a global academic context.

Integration with Learning Management Systems (LMS): Integrating the tool with popular LMS platforms to streamline the plagiarism detection process, making it more convenient for educators.

Real-Time Monitoring: Exploring real-time monitoring capabilities to enable educators to identify AI-generated content as it is being submitted, allowing for more proactive interventions.

Adaptive Learning: Implementing adaptive learning mechanisms that allow the tool to continuously learn and improve based on user feedback and the changing landscape of AI-generated content.

6.4 Conclusion

The development and evaluation of the AI-based plagiarism detection tool have yielded valuable insights into the challenges of academic integrity in the digital age. The tool has demonstrated significant potential in identifying AI-generated content, but ongoing development and refinement are necessary to address its limitations and enhance its capabilities. The project underscores the need for educators, institutions, and researchers to proactively adapt to the evolving landscape of AI and its impact on academic work. The tool's potential for future development, along with a commitment to ethical considerations and responsible use, hold promise for fostering a more robust academic integrity framework in the digital age.

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