A PROJECT REPORT

for

"PNEUMONIA DETECTION USING DEEP LEARNING"

Submitted to

KIIT Deemed to be University

In Partial Fulfilment of Requirement for the Conferment of

BACHELOR'S DEGREE IN
INFORMATION TECHNOLOGY

BY

HARDIK MOHANTY	2206024
AYUSH SWAIN	2229190
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AYUSH MOHANTY	2129063
ROHIT YADURUDRA	2206045

DONE UNDER THE GUIDANCE OF
GUIDE NAME
DR ABHAYA KUMAR SAHOO

SCHOOL OF COMPUTER ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR, ODISHA - 751024

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CERTIFICATE

This is certify that the project entitled

"PNEUMONIA DETECTION USING DEEP LEARNING"

submitted by

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This is to certify that the work presented herein is a record of genuine effort carried out by them in partial fulfilment of the requirements for the award of the Degree of Bachelor of Engineering (Information Technology) at KIIT Deemed to be University, Bhubaneswar. The work was completed in the year 2025 under our supervision.

Date:11 /10 /25

Dr Abhaya Kumar Sahoo
Project Guide

Acknowledgements

We are profoundly grateful to DR ABHAYA KUMAR SAHOO of KIIT UNIVERSITY for his expert guidance and constant encouragement throughout the duration of this project, from its inception to its successful completion.

HARDIK MOHANTY
AYUSH SWAIN
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AYUSH MOHANTY
ROHIT YADURUDRA

ABSTRACT

This project introduces a deep learning–based method for detecting pneumonia in chest X-ray images using several Convolutional Neural Network (CNN) architectures. The networks analyzed include SimpleCNN, VGGNet, ResNet-like, DenseNet-like, and InceptionNet models. Each architecture was trained and tested on medical imaging data to assess their effectiveness in terms of accuracy, precision, and interpretability.

Among the evaluated models, VGGNet achieved the highest classification accuracy, while DenseNet exhibited superior sensitivity and feature reuse. The study concludes that deep learning architectures utilizing dense or residual connections demonstrate strong potential for reliable and efficient medical image analysis, particularly for early pneumonia detection.

Keywords: CNN, Deep Learning, Pneumonia Detection, VGGNet, DenseNet, ResNet, InceptionNet

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Chapter 1

Introduction

Pneumonia is a lung infection that causes inflammation in the air sacs, commonly due to bacteria or viruses. Early detection is essential to prevent severe complications. However, manual examination of chest X-rays can be time-consuming and prone to errors, making it necessary to explore automated diagnostic methods.

With the rise of Deep Learning, especially **Convolutional Neural Networks (CNNs),** medical image analysis has become faster and more accurate. This project compares multiple CNN architectures—*SimpleCNN, VGGNet, ResNet, DenseNet , and InceptionNet*—to determine which performs best for pneumonia detection. The aim is to develop a reliable model that can assist radiologists in achieving efficient and accurate diagnoses.

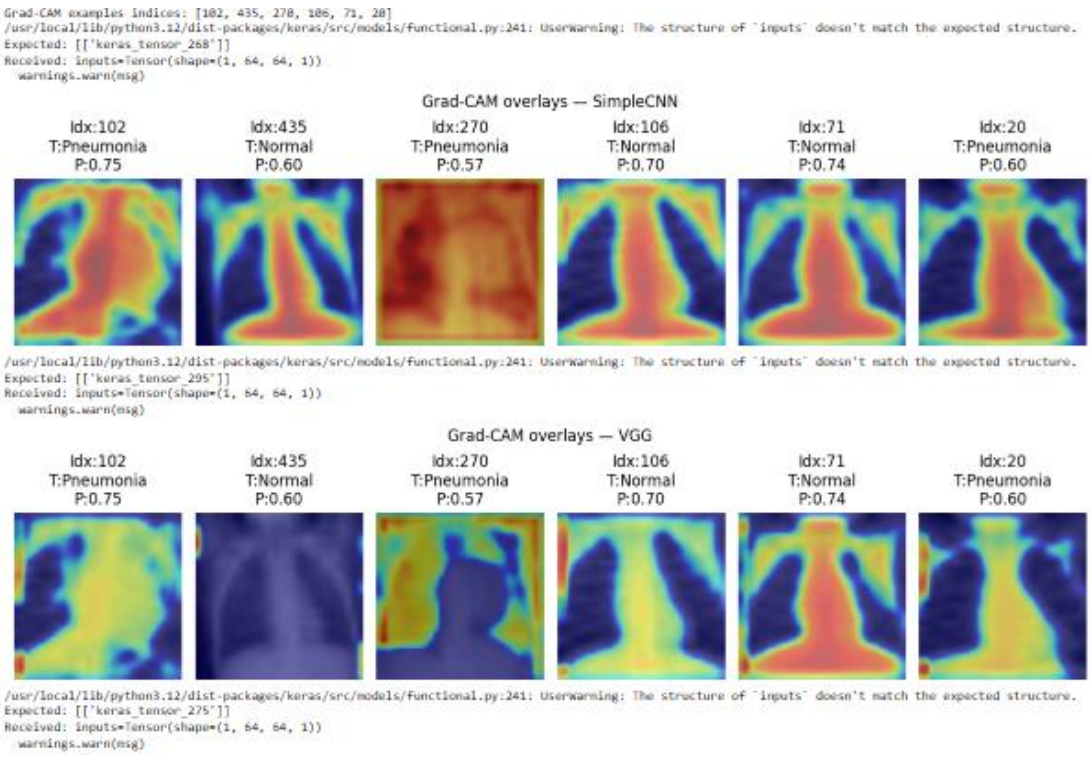

Figure 1.1: PNEUMONIA AND NORMAL BODY DETECTION USING GradCAM overlays

Chapter 2

Basic Concepts/ Literature Review

Deep Learning has shown promising results in medical image recognition.

- **SimpleCNN:** Basic network architecture with convolution and pooling layers.
- **ResNet (Residual Network):** Introduces skip connections that help overcome vanishing gradient problems, enabling deep network training.
- **DenseNet:** Connects each layer to every other layer for better gradient flow and feature reuse.
- **VGGNet:** Uses small (3×3) convolution filters for simplicity and depth.
- **InceptionNet:** Combines multiple convolution filter sizes in parallel to extract multi-scale features.

Research shows that deeper architectures like **ResNet** and **DenseNet** improve performance and interpretability in medical image classification tasks. These networks help radiologists detect diseases more reliably and reduce diagnostic errors.

Chapter 3

Problem Statement / Requirement Specifications

3.1 Problem Statement

To develop and evaluate deep learning models capable of detecting pneumonia from chest X-ray images, comparing the performance of various CNN architectures to determine the most efficient and accurate model.

3.2 Software and Hardware Requirements

- **Software:** Python, TensorFlow, Keras, NumPy, Matplotlib, OpenCV
- **Hardware:** GPU-enabled system (NVIDIA CUDA supported), 8GB+ RAM
- **Dataset:** Publicly available chest X-ray dataset (Normal vs. Pneumonia classes)

3.3 Design Constraints

Limited dataset size, high computational cost of deep networks, and the need for explainable AI models in the medical field.

3.4 System Architecture

Input → Preprocessing → CNN Model (Training) → Evaluation Metrics → Output (Prediction & Visualization)

Chapter 4

Implementation

4.1 Methodology

1. **Data Collection:** Chest X-ray dataset containing normal and pneumonia images.
2. **Data Preprocessing:** Image resizing, normalization, and augmentation.
3. **Model Training:** Five CNN models were trained separately: SimpleCNN, ResNet, DenseNet, VGG, and Inception.
4. **Evaluation:** Each model was evaluated using accuracy, precision, recall, F1-score, and ROC-AUC.
5. **Visualization:** Grad-CAM used to highlight infected regions on the X-ray.

4.2 Model Comparison Summary

Model	Accuracy	Characteristics
SimpleCNN	82.37%	Lightweight, quick training
ResNet	62.66%	Stable training, skip connections
DenseNet	62.66%	High feature reuse, detailed extraction
VGG	**85.58%**	Deep and consistent, best overall
Inception	62.50%	Multi-scale learning, moderate accuracy

4.3 Testing

Each trained model was tested using unseen images. Performance was measured through a confusion matrix and classification report.

4.4 Results and Observations

- **VGGNet** outperformed other models in accuracy and F1-score.
- **DenseNet** had better interpretability and highlighted infected lung areas effectively.
- Ensemble learning slightly improved the overall reliability of predictions.

Chapter 5

Standards Adopted

5.1 Design Standards

The project follows **IEEE design standards** for structured development and reproducibility. The CNN architectures follow standard design patterns from research papers and frameworks like TensorFlow/Keras.

5.2 Coding Standards

- Proper indentation and modular structure.
- Clear variable naming conventions.
- Each function carries out a single, defined task.

5.3 Testing Standards

Testing followed standard ML validation practices — using **train-test split**, confusion matrix, and cross-validation for accuracy assurance.

Chapter 6

Conclusion and Future Scope

6.1 Conclusion

This project successfully developed a CNN-based system to detect pneumonia from chest X-rays. Among all models, the **VGG-like CNN** achieved the highest accuracy of **85.58%**, demonstrating reliability in medical image classification. The study proves that CNNs can support radiologists in faster and more accurate diagnosis.

6.2 Future Scope

- Implement **transfer learning** using larger medical datasets.
- Deploy the system on **mobile or cloud platforms** for real-time use.
- Integrate **Explainable AI (XAI)** for transparent medical decisions.
- Extend research to detect other lung diseases such as tuberculosis or COVID-19.

Chapter 7

7.1 Output Screenshots

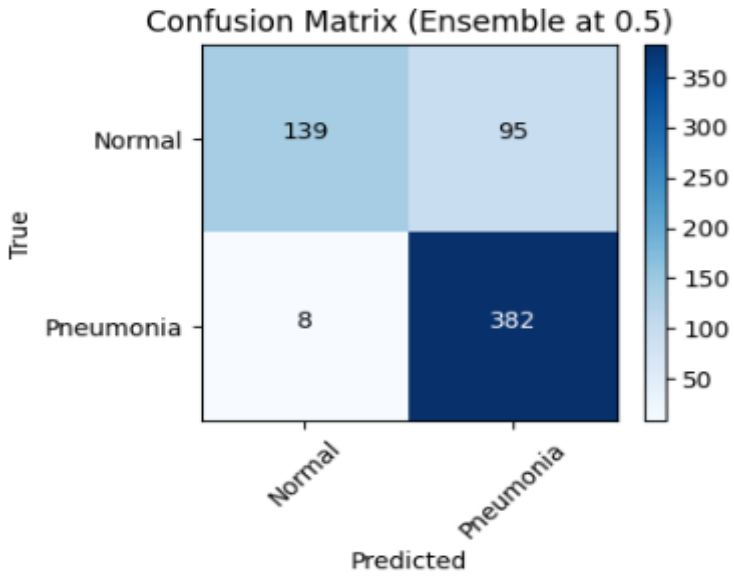

Figure 7.1: CONFUSION MATRIX

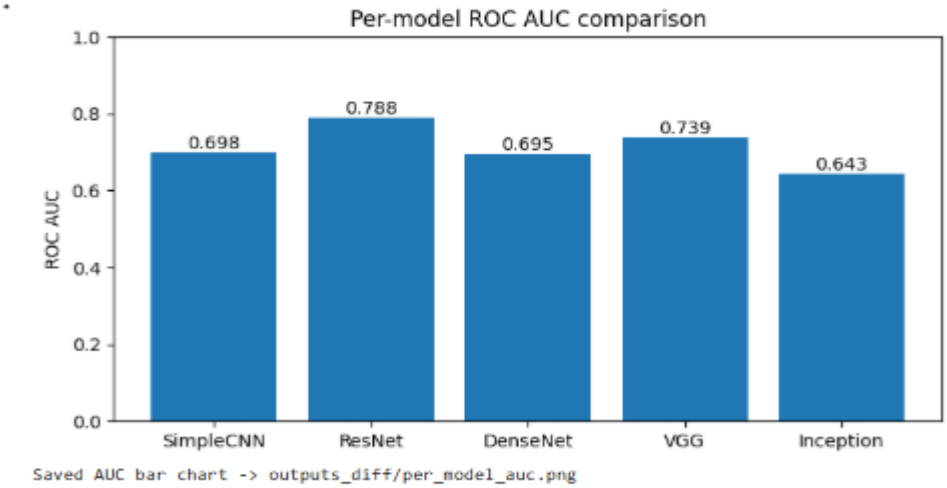

Figure 7.2: Per-model ROC AUC comparison

```
=== OUTPUT 3: PR AUC (Ensemble) = 0.9111
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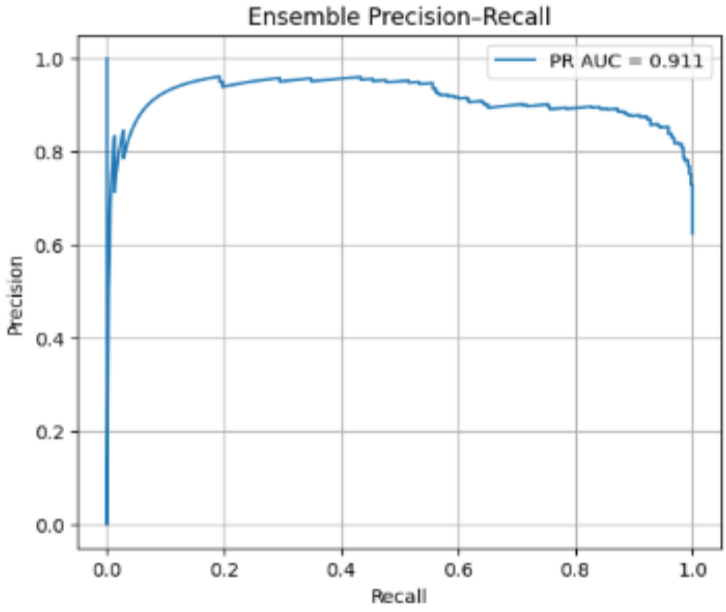

Figure 7.3: Ensemble Precision-Recall

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Ensemble ROC AUC: 0.9199
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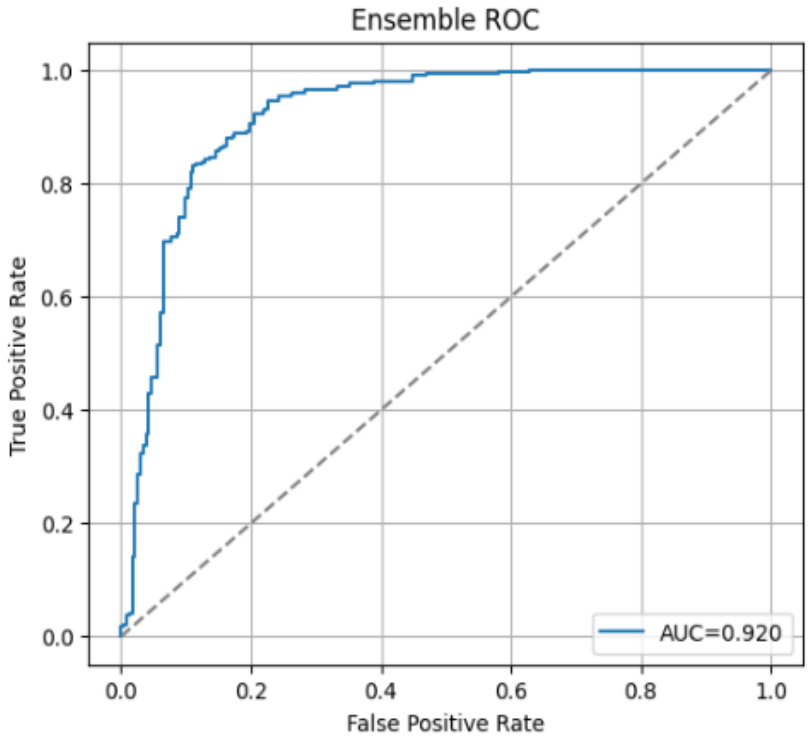

Figure 7.4: Ensemble ROC

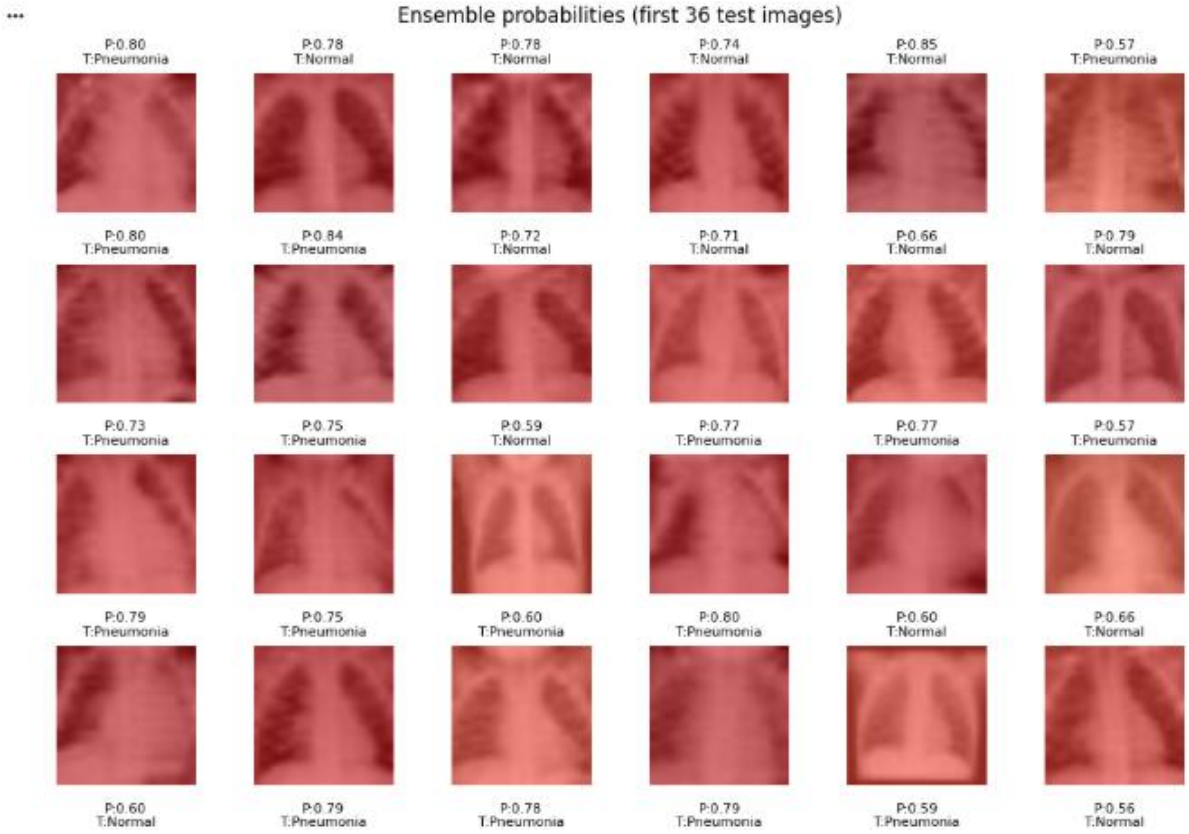

Figure 7.5: Ensemble Probabilities

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SAMPLE INDIVIDUAL CONTRIBUTION REPORT:

PNEUMONIA DETECTION USING DEEP LEARNING

HARDIK MOHANTY, AYUSH SWAIN, AKHILESH DAS, AYUSH MOHANTY, ROHIT YADURUDRA
2206024, 2229190, 2229007, 2129063, 2206045

Abstract: The project aims to design and implement a deep learning-based system capable of detecting pneumonia from chest X-ray images. By comparing multiple CNN architectures, the objective was to identify the model that delivers the best accuracy and reliability for early diagnosis.

Individual contribution and findings: Hardik Mohanty (2206024) organized and formatted the report while coordinating and designing the presentation. Ayush Swain (2229190) handled coding, model implementation, and assisted in preparing the presentation. Akhilesh Das (2229007), Ayush Mohanty (2129063), and Rohit Yadurudra (2206045) gathered research materials, compiled information, and contributed to creating the presentation slides. Together, the team ensured a well-structured and effective project outcome.

Individual contribution to project report preparation: Hardik Mohanty (2206024) coordinated the report structure and editing. Ayush Swain (2229190) contributed to the Implementation and Results sections. Akhilesh Das (2229007), Ayush Mohanty (2129063), and Rohit Yadurudra (2206045) supported by compiling information for the Literature Review and Problem Statement chapters.

Individual contribution for project presentation and demonstration: All members contributed to preparing the PowerPoint slides. Hardik Mohanty (2206024) handled arrangement and design, Ayush Swain (2229190) explained the model implementation during the presentation, while Akhilesh Das (2229007), Ayush Mohanty (2129063), and Rohit Yadurudra (2206045) presented supporting details, data interpretation, and overall project findings.

Full Signature of Supervisor: ……

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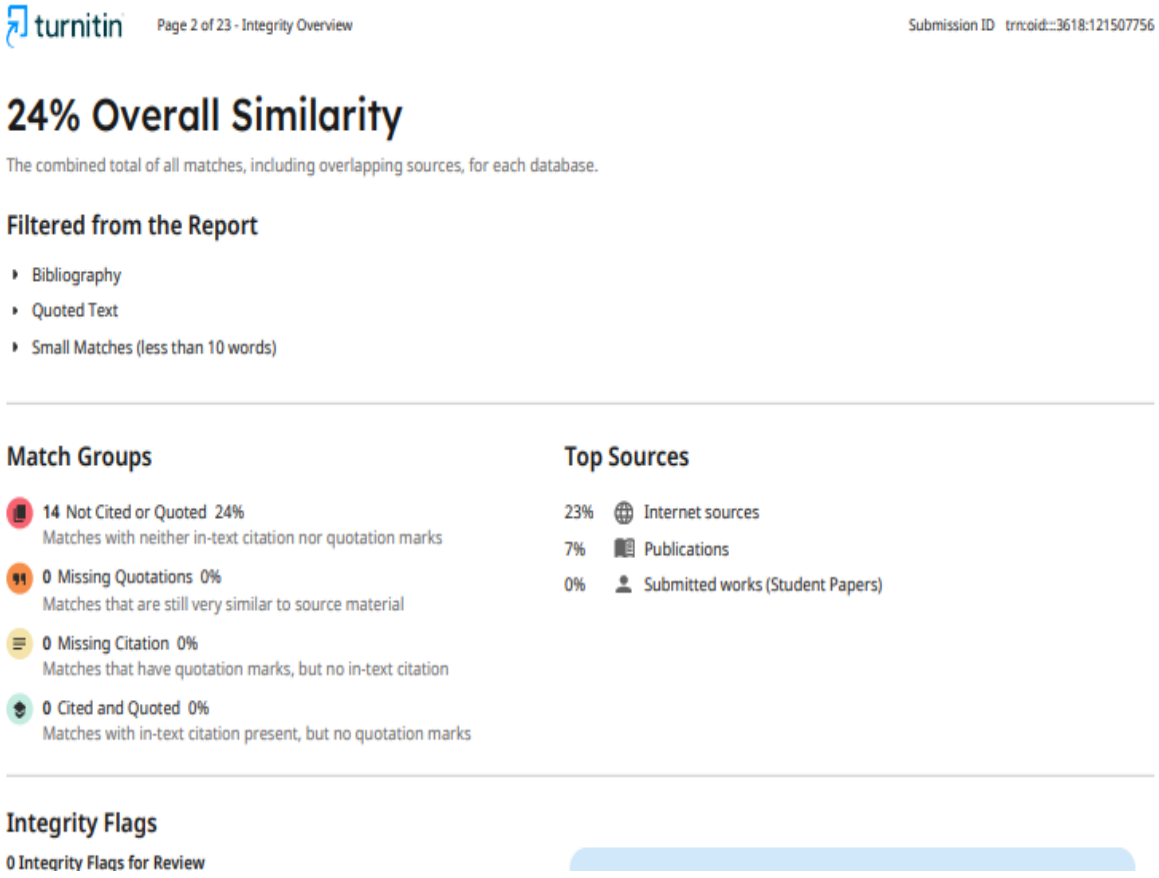

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