Radiology Report Generation from Chest X-ray Image

Team Members:

Abilash Maharjan [THA077BCT004]

Anmol Kumar Gupta [THA077BCT011]

Shailendra Rawal [THA077BCT041]

Supervised By:

Er. Suramya Sharma Dahal

Department of Electronics and Computer Engineering
Institute of Engineering, Thapathali Campus

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Presentation Outline

- Motivation
- Objectives
- Scope of Project
- Proposed Methodology
- Instrumentation Tools
- Expected Outcomes
- Project Application
- Gantt Chart
- Estimated Project Budget
- References

Motivation

- Increasing demand for radiological services
- Need to reduce diagnostic turnaround time
- Importance of enhancing consistency and accuracy in radiology reports
- Improve patient outcomes by enabling faster, reliable and better-informed treatment decisions
- AI-driven solutions to transform healthcare practices

Objectives

- To develop an AI-driven system that can accurately classify chest X-ray images into various disease categories and generate detailed findings and impressions.
- To create a user-friendly web portal that allows healthcare professionals to upload chest X-ray images, view AI-generated reports, edit findings if necessary, and download the final report in PDF format.

Scope of Project [1]

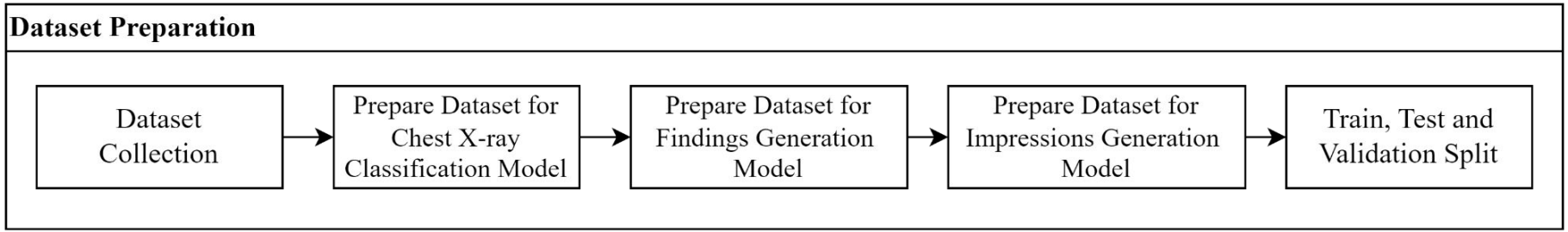
- **Project Capabilities**
  - Advanced AI Integration for Radiology
  - User-Friendly Clinician Interface
  - Implement optimization techniques to enhance processing efficiency

Scope of Project [2]

- **Project Limitations**
  - Requires continuous maintenance and updates to adapt and learn the ever-evolving medical knowledge
  - Inconsistent Image Quality may lead to inaccurate results
  - Integration Challenges into EHR systems

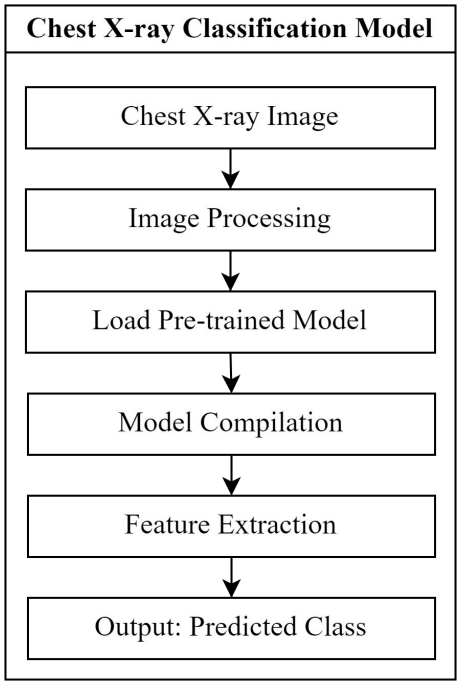
Methodology

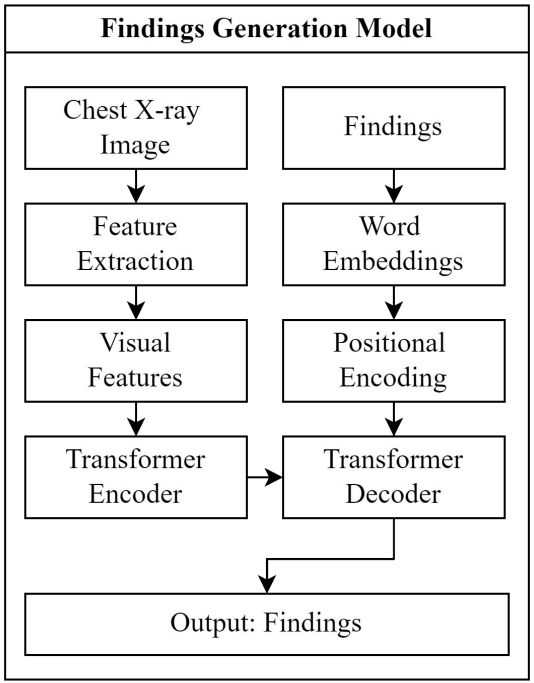
- **System Architecture [1]**

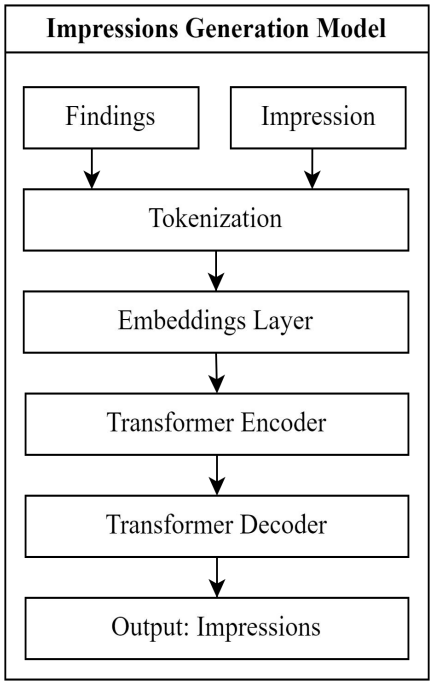


Methodology [Cont.]

- **System Architecture [2]**

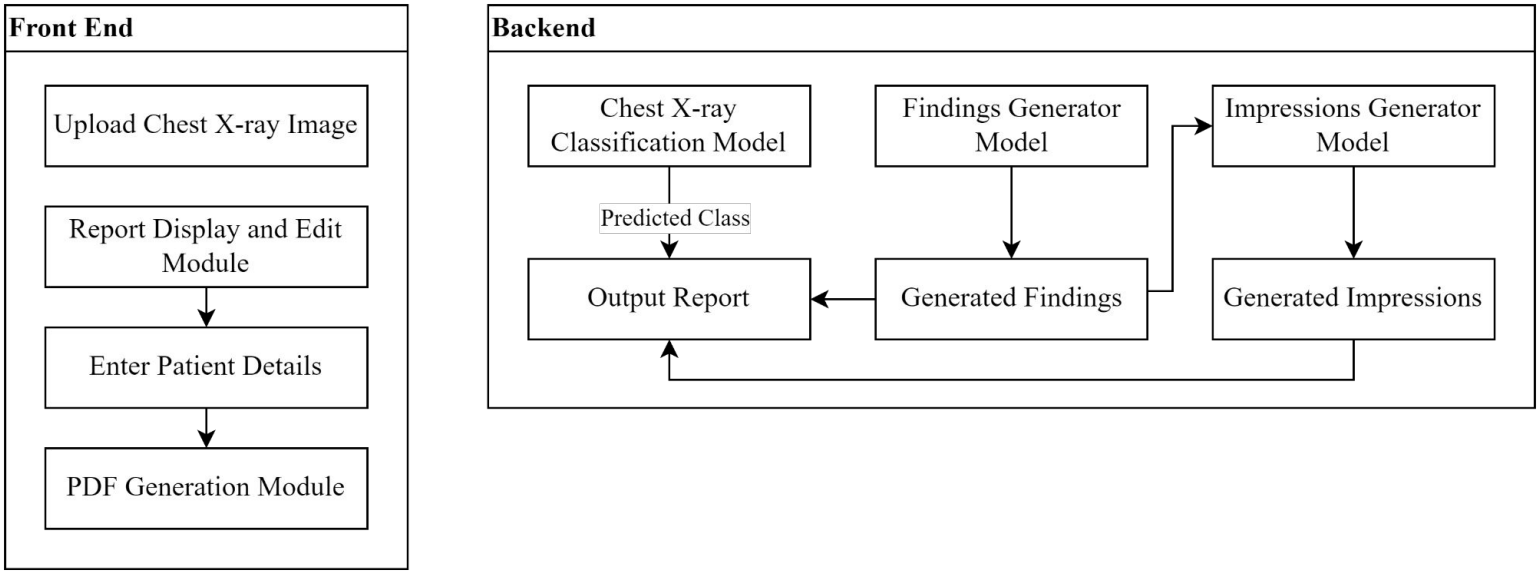






Methodology [Cont.]

- **System Architecture [3]**



Methodology [Cont.]

- **Dataset Preparation**
  - Dataset Collection
  - Prepare Dataset for Chest X-ray Classification Model
  - Prepare Dataset for Findings Generation Model
  - Prepare Dataset for Impressions Generation Model
  - Train, Test, and Validation Split

Methodology [Cont.]

- **Machine Learning Models [1]**
  - **Chest X-ray Classification Model**
    - Image Processing to fit in chosen CNN architecture
    - Load Pre-trained Model like ResNet, DenseNet or EfficientNet
    - Model is compiled with appropriate loss functions, optimizers and evaluation metrics
    - Extract relevant features
    - Predicted class is given as output
    - Training and Fine-tuning

Methodology [Cont.]

- **Machine Learning Models [2]**
  - **Findings Generation Model**
    - CNN or ViT for visual features extraction
    - Feed into transformer encoder
    - Convert findings text into embeddings
    - Process the features and findings
    - Output detailed text finding
    - Training and Fine-tuning
    - Model evaluation and testing

Methodology [Cont.]

- **Machine Learning Models [3]**
  - **Impressions Generation Model**
    - Tokenize findings
    - Convert into embeddings
    - Process embeddings
    - Generate high-level impressions
    - Output summarized impressions
    - Training and Fine-tuning
    - Model evaluation and testing

Methodology [Cont.]

- **Dataset Analysis**

  For generating report from Chest X-ray image, the following set of data will be used.

  1. PhysioNet MIMIC-CXR
  2. Indiana University (IU) Chest X-ray
  3. NIH Chest X-rays

Instrumentation Tools [1]

1. Software Requirements

- Python
- PyTorch
- NumPy
- Pandas
- Matplotlib
- OpenCV
- PyPDF2
- VS Code
- Django
- HTML, CSS, JS

Instrumentation Tools [2]

2. Hardware Requirements

- **CPU**: Intel Octa-core i5 1.60GHz or higher CPU
- **GPU**: NVIDIA K80, T4, P4 or P100 (Google Colab)

  NVIDIA Tesla P100 (Kaggle)

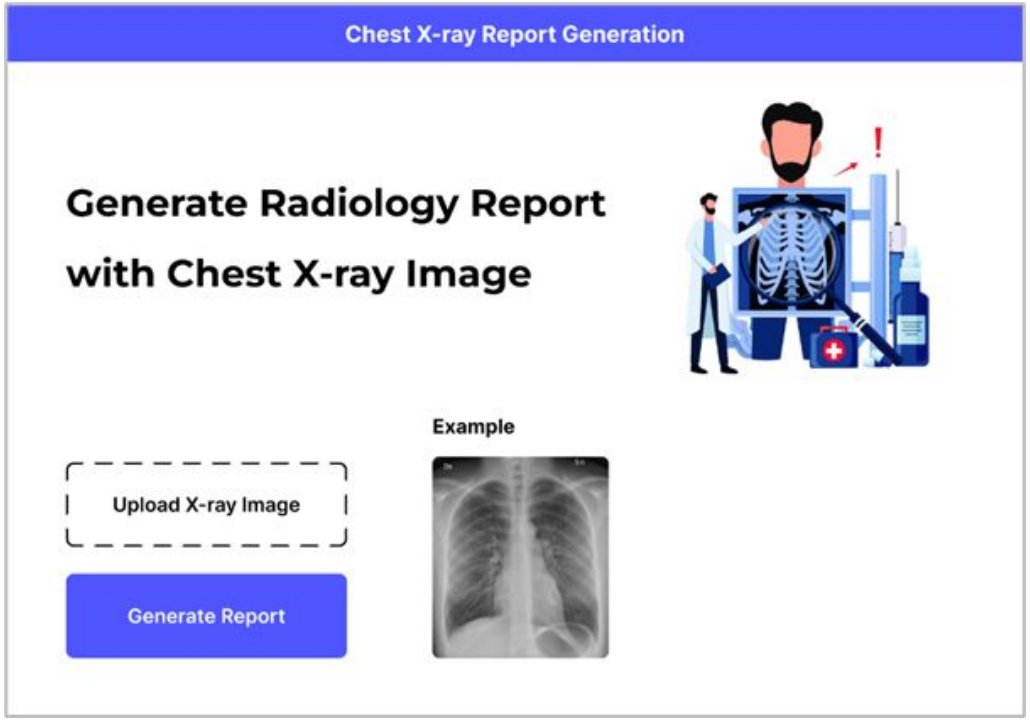
- **RAM**: Minimum 8GB
- **Storage**: 512 GB SSD or higher

Expected Outcomes [1]

- Report Generation
- Improved Workflow Efficiency
- User Interface

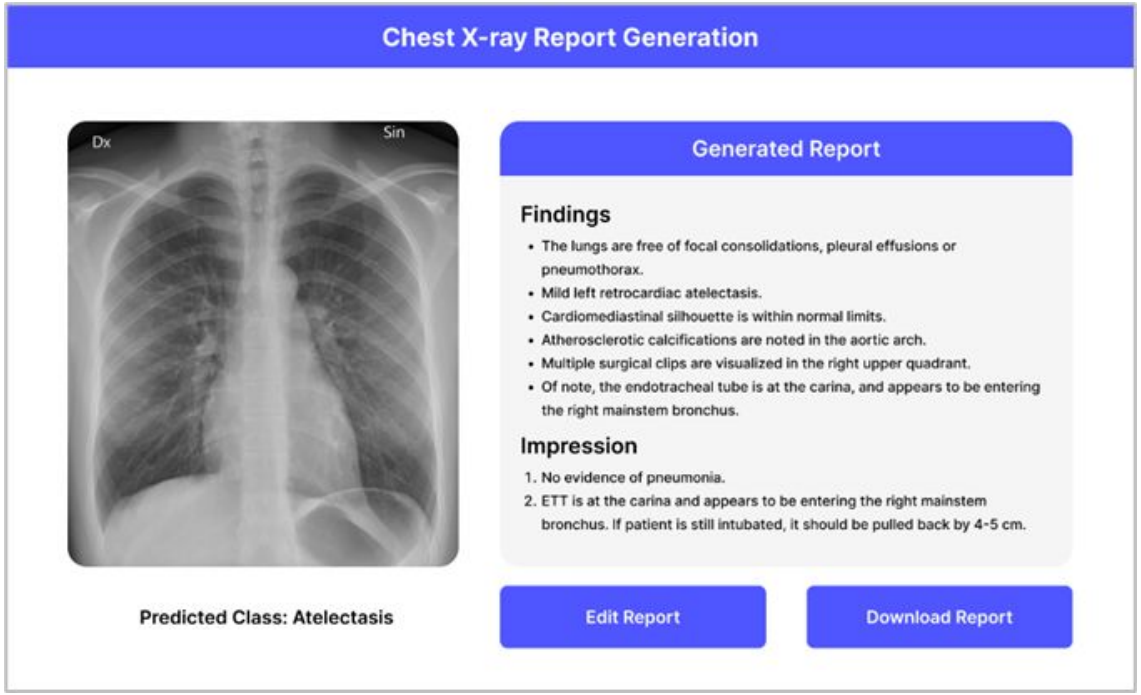
Expected Outcomes [2]

Figure: Design of Home Page of Web Portal



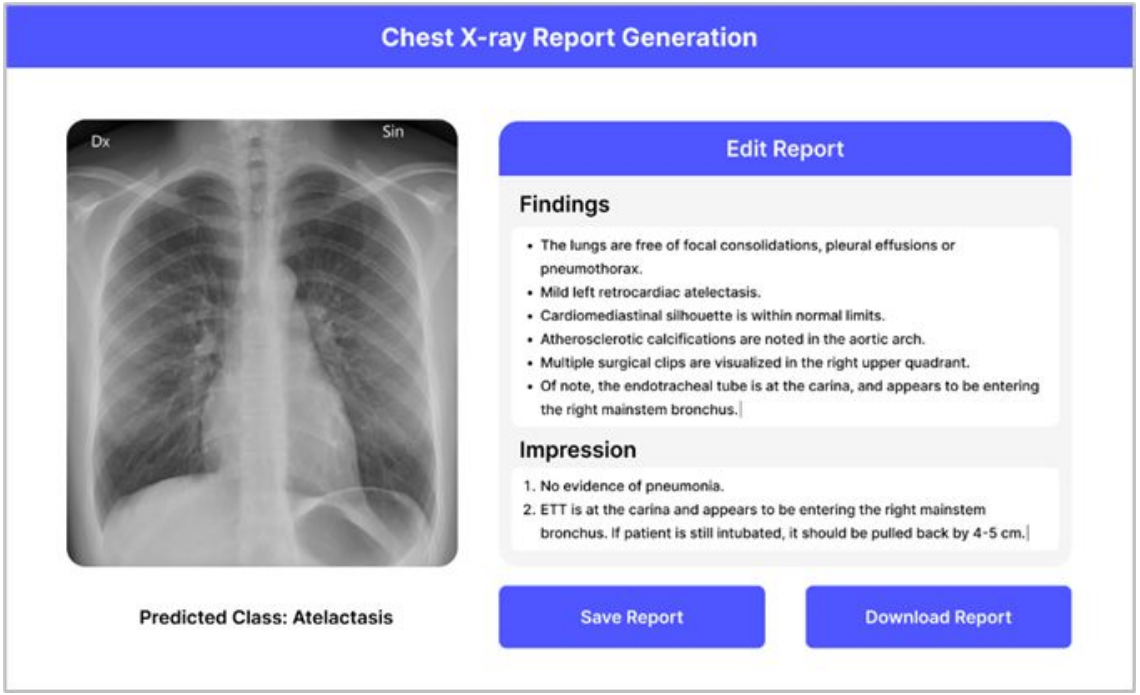
Expected Outcomes [3]

Figure: Design of Generated Report Page



Expected Outcomes [4]

Figure: Design of Edit Report Page



Expected Outcomes [5]

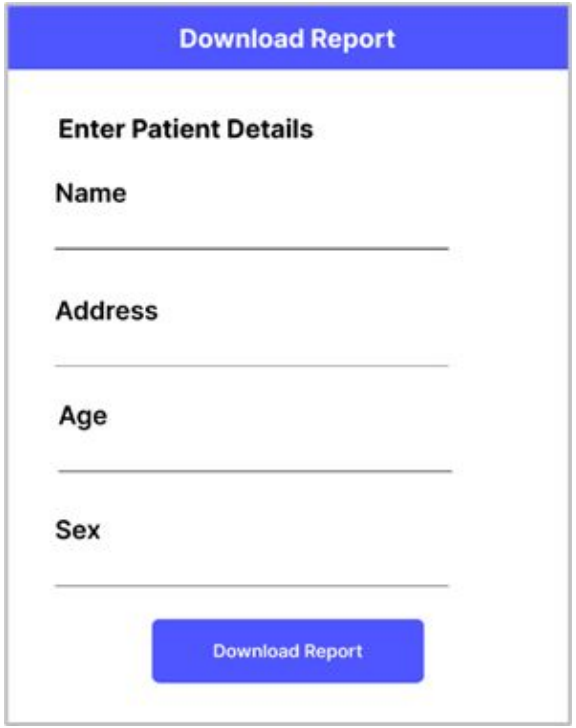


Figure: Download Report Interface

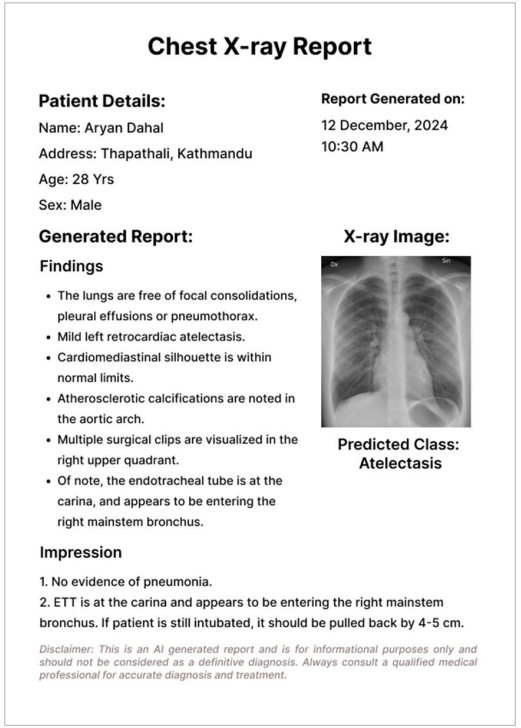
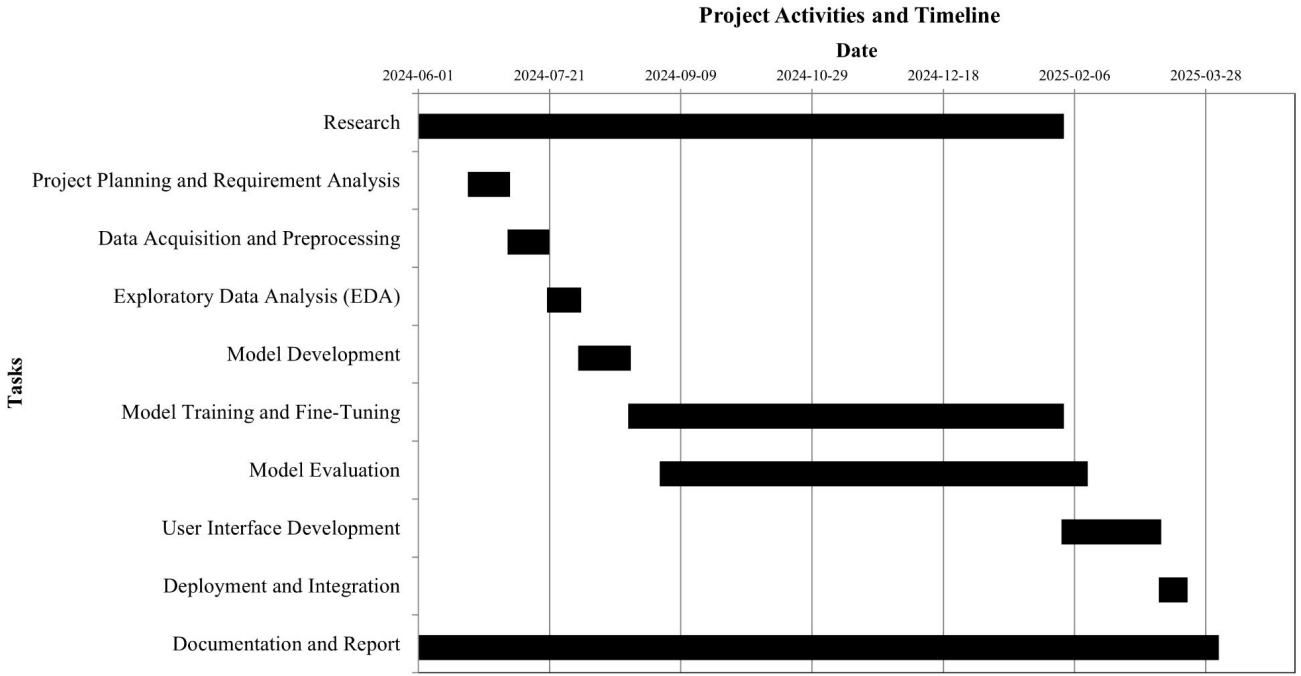


Figure: Sample of Radiology Report in PDF Format

Project Applications

- Automated Reporting
- Telemedicine
- Educational Tool
- Comprehensive Patient Records
- Development of new diagnostic tools

Gantt Chart


Project Activities and Timeline
Date
2024-06-01
2024-07-21
2024-09-09
2024-10-29
2024-12-18
2025-02-06
2025-03-28
Tasks
Research
Project Planning and Requirement Analysis
Data Acquisition and Preprocessing
Exploratory Data Analysis (EDA)
Model Development
Model Training and Fine-Tuning
Model Evaluation
User Interface Development
Deployment and Integration
Documentation and Report

Estimated Project Budget

S.N.	TOPIC	COST (Rs.)
1.	Printing & Documentation	3,000
2.	Computing Resources	8,000
3.	Deployment	2,000
4.	Miscellaneous	2,000
Total		**15,000**

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