

IMPROVING GENERALIZATION IN CHEST XRAY CLASSIFICATION USING DEEP LEARNING

RESEARCH METHOD AND PROFESSIONAL DEVELOPMENT [ACFA7004]

RESEARCH PRESENTATION

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RESEARCH BACKGROUND

- Chest X-rays (CXR) are widely used for detecting pneumonia and other lung diseases [1].
- AI models help automate diagnosis, but they fail when applied to **new datasets** (trained on one hospital's data but fail on another).
- According to [1] DenseNet had **98.81% accuracy on Kermany's dataset** but dropped to **86.85% on RSNA**.
- In real-world hospitals, AI must work well across different X-ray datasets.
- Improving **generalization** makes AI diagnosis **more reliable** for doctors and patients.

RESEARCH PROBLEM

- AI models trained on one dataset often fail when tested on another due to variations in imaging conditions, patient demographics, and imaging techniques [1].
- Many studies focus on **high accuracy within a single dataset** but overlook **cross-dataset performance** [2].
- **Identified Research Gap:**
 - Existing models lack **generalization**, meaning they perform poorly when tested on different datasets [1].
 - There is a need for **improved transfer learning and augmentation techniques** to enhance cross-dataset performance [4].
- **Research Challenge:**
 - Can we develop a deep learning model that maintains high accuracy **across different datasets**, ensuring reliability in real-world clinical use?

RESEARCH AIM AND OBJECTIVE

► Research Aim:

- To improve the generalization of deep learning models for chest X-ray classification and achieve **above 86.85% accuracy on RSNA**.

► Objectives:

- 1 Identify the reason behind poor generalization in AI models.
- 2 Train a deep learning model (ResNet, DenseNet, CNN) on one dataset [1].
- 3 Test it on another dataset (RSNA Pneumonia Dataset) and evaluate accuracy drop [1].
- 4 Apply **transfer learning, fine-tuning, and data augmentation** to improve the generalization

LITERATURE REVIEW

- **Existing Studies on Deep Learning for Chest X-ray Classification.**
- Various CNN-based models, pre-trained architectures, and hybrid approaches have been explored.
- **Common Challenges Identified in Previous Research:**
 - Models tend to overfit on a single dataset, leading to poor generalization [1], [2].
 - Data imbalance issues where certain classes dominate the dataset [3].
 - Computational cost of deep learning models, making real-time clinical implementation difficult [4].

- **Relevant Contributions from Existing Studies:**
 - Pre-trained models (e.g., DenseNet121, CheXNet) improve accuracy but still struggle with cross-dataset performance [1].
 - Hybrid models combining CNN with LSTM or SVM have been explored to enhance classification accuracy [2], [3].
 - Data augmentation and transfer learning have shown potential in improving generalization [4].

METHODOLOGY

LAYER	RESEARCH CHOICES	EXPLANATION
Research Philosophy	Positivism	Focuses on objective, data-driven analysis of model performance.
Research Approach	Deductive	Tests existing AI model generalization theories using experiments.
Research Strategy	Experimental	Train models on one dataset and test on another to measure generalization.
Data Collection	Publicly Available Datasets (ChestX-ray14, RSNA)	No need for manual data collection, saves time.
Data Analysis	Performance Metrics (Accuracy, Precision, Recall, F1-score, AUC-ROC)	Evaluates how well the model generalizes across datasets.

RESEARCH METHOD

► **Model Choice:**

- **Selected Models:** ResNet, DenseNet, or CNN-based architecture [1].
- **Why These Models?**
 - CNNs extract essential features from images.
 - ResNet & DenseNet handle deep learning challenges like vanishing gradients [2].

► **The ways to Improve Generalization:**

- **Transfer Learning:** Fine-tune a pre-trained model on a second dataset [3].
- **Data Augmentation:** Apply transformations (flipping, rotation, adding noise) to increase dataset diversity [4].
- **Hyperparameter Tuning:** Optimize learning rate, batch size, and training epochs for better accuracy [1].

MODEL EVALUATION

- **Performance Metrics:**
 - **Accuracy:** Measures overall correctness [1].
 - **Precision & Recall:** Balances false positives and negatives [2].
 - **F1-score:** Harmonic mean of precision and recall [3].
 - **AUC-ROC Curve:** Evaluates classification performance [4].
- **Success Criteria:**
 - Achieve **>86.85% accuracy on RSNA dataset** [1].
 - Reduce performance drop when switching datasets [1].

PROJECT PLANNING AND RESOURCES

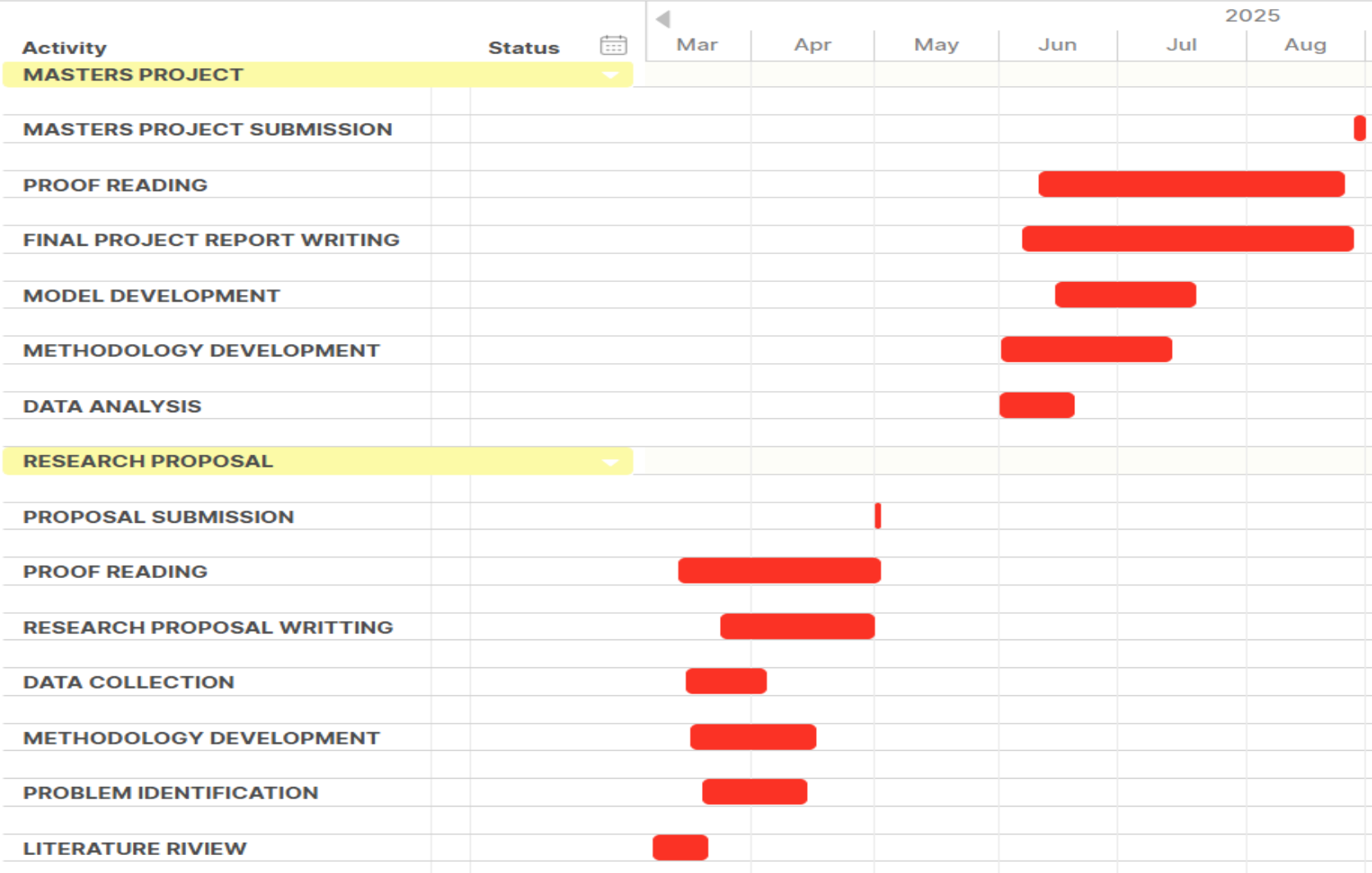
► RESOURCES

- **Datasets:** ChestX-ray14, RSNA Pneumonia Dataset [1].
- **Software:** Python, TensorFlow/PyTorch, Jupyter Notebook.
- **Hardware:** GPU-enabled system for model training [3].

► CHALLENGES

- Computational limitations (high GPU demand for deep learning models).

PROJECT PLANNING - GANTT CHART



PROJECT IMPACT AND LIMITATIONS

- **Impact of This Research:**
 - Improves AI model generalization for pneumonia detection across different datasets [1].
 - Enhances **real-world clinical usability** of AI-powered diagnosis tools [2].
 - Reduces the need for retraining models on new hospital datasets.
- **Limitations:**
 - **Dataset Bias:** Some datasets may not fully represent diverse patient populations [4].
 - **Hardware Limitations:** Training deep learning models requires high computational power [3].
 - **Ethical Concerns:** AI models must be transparent and explainable for clinical use [2].

REFERENCES

- [1] S. Sharma and K. Guleria, "A systematic literature review on deep learning approaches for pneumonia detection using chest X-ray images," *Multimedia Tools and Applications*, vol. 83, pp. 24101-24151, 2024.
- [2] E. Jain and R. Bhardwaj, "Automated cardiomegaly detection from chest X-rays using deep convolutional neural networks: A novel approach for improved diagnosis," *IEEE SMART-2024 Conference*, 2024.
- [3] E. E. Khaing and T. Z. Aung, "Lung disease classification from chest X-ray images using convolutional neural network and long short-term memory model," *IEEE AllIoT 2024 Conference*, 2024.
- [4] S. Prathwini, S. Shravya, and S. Shreenath, "Unveiling COVID-19: Detection from chest X-ray images using CNN," *IEEE NMITCON 2024 Conference*, 2024.

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the left and right sides of the frame, leaving a large white central area.

THANK YOU.....