Summit to: Computational Material Science

Image-based Air Pollution Analysis using Deep Learning Algorithms

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EXTENDED ABSTRACT: Accurate analysis and continuous monitoring of air pollution are of paramount importance in shaping effective policies, guiding public health interventions, and driving environmental protection initiatives. The profound impact of air pollution on both the environment and public health underscores the necessity for robust and informed approaches. This study recognizes the prevalent trend of individuals sharing thoughts and images related to air pollution on social media platforms, prompting a focused examination of air pollution identification through photograph analysis. The research specifically targets the assessment of Air Quality, utilizing an extensive Image Dataset sourced from regions in Nepal and India. To accomplish this, two advanced Deep Learning models are employed: the Convolutional Neural Network (CNN) and the Long Short-Term Memory (LSTM). These models are chosen for their proven effectiveness in image analysis tasks, allowing for a comprehensive exploration of their applicability to air pollution identification. The study delves into the nuanced relationship between critical factors such as training duration, model architecture, and convergence behavior. This exploration is vital for gaining a deep understanding of the dynamics involved in the development and optimization of these models for accurate air pollution analysis. To further enhance the assessment of model performance, the study employs rigorous statistical tests and utilizes Receiver Operating Characteristic (ROC) curves, providing a comprehensive evaluation framework. A meticulous comparative analysis is conducted to emphasize the distinct performance and convergence characteristics of the CNN and LSTM models. These algorithms gave high testing accuracies of 96.49% and 85.87%, respectively. Notably, the findings illuminate that the optimal training duration exhibits variability across models. Some models demonstrate early convergence, showcasing efficiency in learning, while others benefit from extended training periods, suggesting a nuanced relationship between model complexity and training requirements. In the broader context of image analysis for air pollution, this study offers an exploration of the strengths and weaknesses inherent in each approach. By presenting a comprehensive comparison of results, the research contributes valuable insights that can inform future endeavors in leveraging deep learning models for air pollution assessment and management.

Keywords: Air pollution; Deep Learning; CNN; images; LSTM; dataset

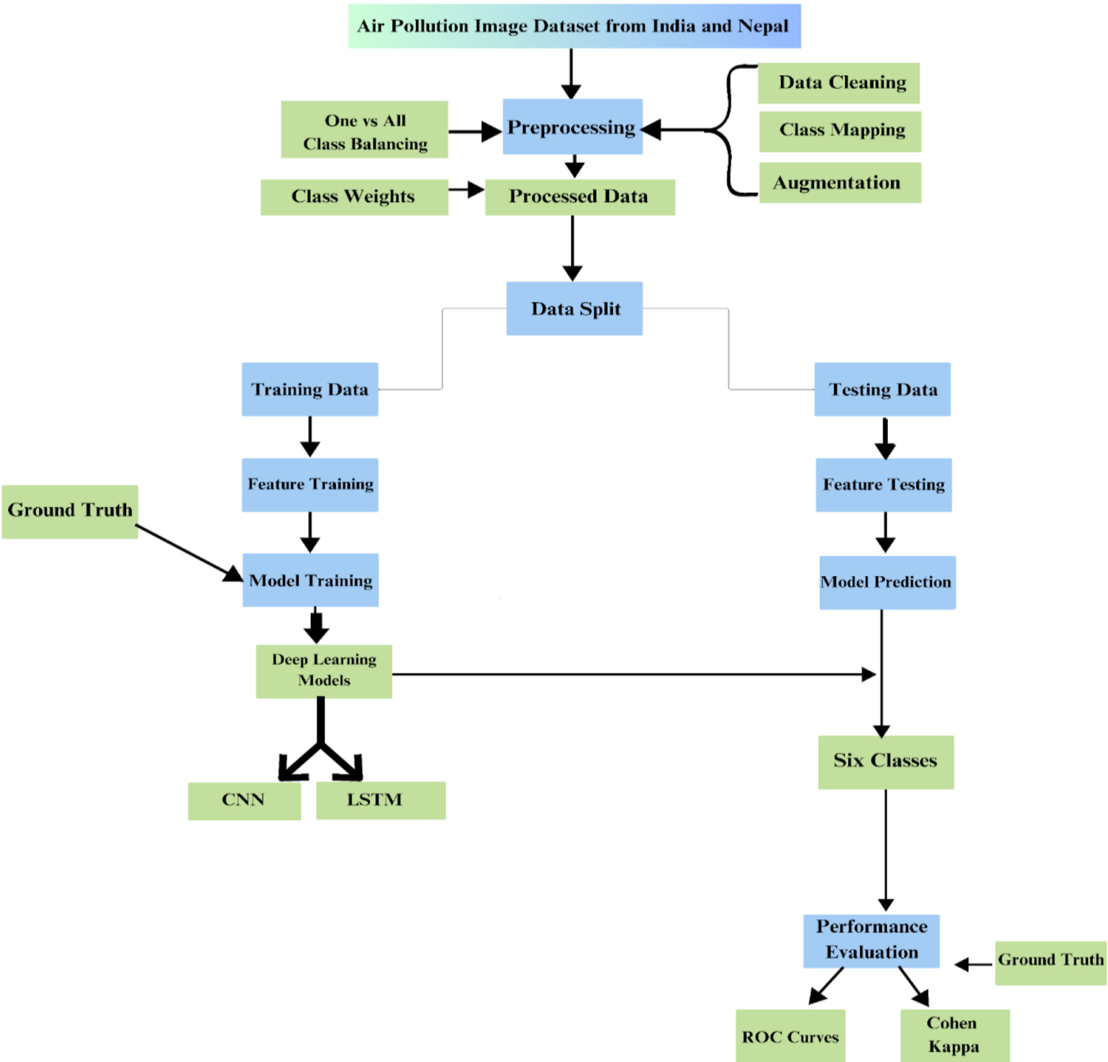

Figure 1. System Architecture – Visual representation of the project workflow, encompassing data preprocessing, class weight, data splitting, feature extraction, model training, and prediction, illustrating the sequential steps leading to the final solution.

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BIOGRAPHY

Muskan Joshi is pursuing her Bachelor of Technology (B.Tech) degree from Indira Gandhi Delhi Technical University for Women (IGDTUW), located in New Delhi, India. She is a dedicated researcher interested in the fusion of Artificial Intelligence (AI) and Machine Learning (ML) with diverse sectors such as healthcare, biology, and social causes. From January 2024 Muskan is serving as a Research Intern in the Computational Biology Department at Carnegie Mellon University School of Computer Science, working on Biomedical Image Analysis. In her research pursuits, Ms. Joshi focuses on unraveling the vast potential of AI and ML in various applications. Her research interests span a wide array of cutting-edge domains, including Machine Learning, Artificial Intelligence, Deep Learning, Image Processing, and Data Science.