Project Design Phase

The design of the system followed a modular approach, ensuring flexibility, scalability, and ease of maintenance. The architecture was divided into the following layers:

1. **Data Layer**: Responsible for acquiring and managing input images, including scanning pollen slides or importing images from online repositories.
2. **Preprocessing Layer**: Images were enhanced using techniques such as contrast adjustment, Gaussian blur, and edge detection to highlight key features.
3. **Feature Extraction and Classification Layer**: Leveraging deep convolutional neural networks (CNNs), this core layer extracted morphological features (e.g., shape, texture, surface pattern) and performed multi-class classification.
4. **Application Layer**: A simple and user-friendly interface, developed using Flask/Streamlit, allowed users to upload images and visualize classification results.
5. **Storage & Logging**: Predicted results and metadata were logged for later review, useful for audits or longitudinal studies.

This design ensured not only functional completeness but also adaptability to future enhancements, such as integrating new pollen types or expanding into multi-label classification.