Project Design Phase

Solution Architecture

Date	15 February 2025
Team ID	LTVIP2025TMID32756
Project Name	Pollen's Profiling: Automated Classification of Pollen Grains
Max Marks	4 Marks

Solution Architecture:

The solution architecture for the Pollen's Profiling project is designed to automate the identification and classification of pollen grains using AI and image processing techniques. It bridges the gap between manual microscopic examination and automated digital analysis, offering speed, accuracy, and scalability.

Goals of the Architecture:

- Automate the classification of various types of pollen grains using AI/ML.
- Minimize human error and time in microscopic analysis.
- Provide a scalable and efficient framework for biological research labs and environmental monitoring agencies.

Key Components:

Data Collection Layer

High-resolution microscope or digital camera captures pollen grain images. Images stored in cloud-based storage (e.g., AWS S3 or Google Cloud Storage).

Preprocessing Module

Image enhancement and noise reduction. Segmentation of pollen grains from the background. Standardization of image sizes and resolution.

Feature Extraction

Use of image processing techniques (e.g., shape, texture, surface pattern analysis). Extraction of features like pollen grain size, morphology, and aperture characteristics.

Machine Learning Model

Deep Learning (CNN – Convolutional Neural Network) model for classification. Model trained using labeled datasets of pollen types. Continuous learning via new input data (Active Learning).

Database

Stores images, metadata, classification results, and logs. Enables search and retrieval of past data for research and validation.

User Interface

Dashboard for uploading images and viewing classification results. Visualization tools to compare predicted vs. actual pollen types. Exportable reports and analytical insights.

Backend Services

APIs for model inference and database access. Security modules for data integrity and access control.

Cloud Infrastructure

Deployed on scalable cloud platforms (e.g., AWS, Azure, GCP). Ensures availability, load balancing, and fault tolerance.

Example Solution Architecture Diagram (Conceptual)

Microscope/Camera → Image Preprocessing → Feature Extraction → Trained CNN Model → Classification Result → UI Dashboard

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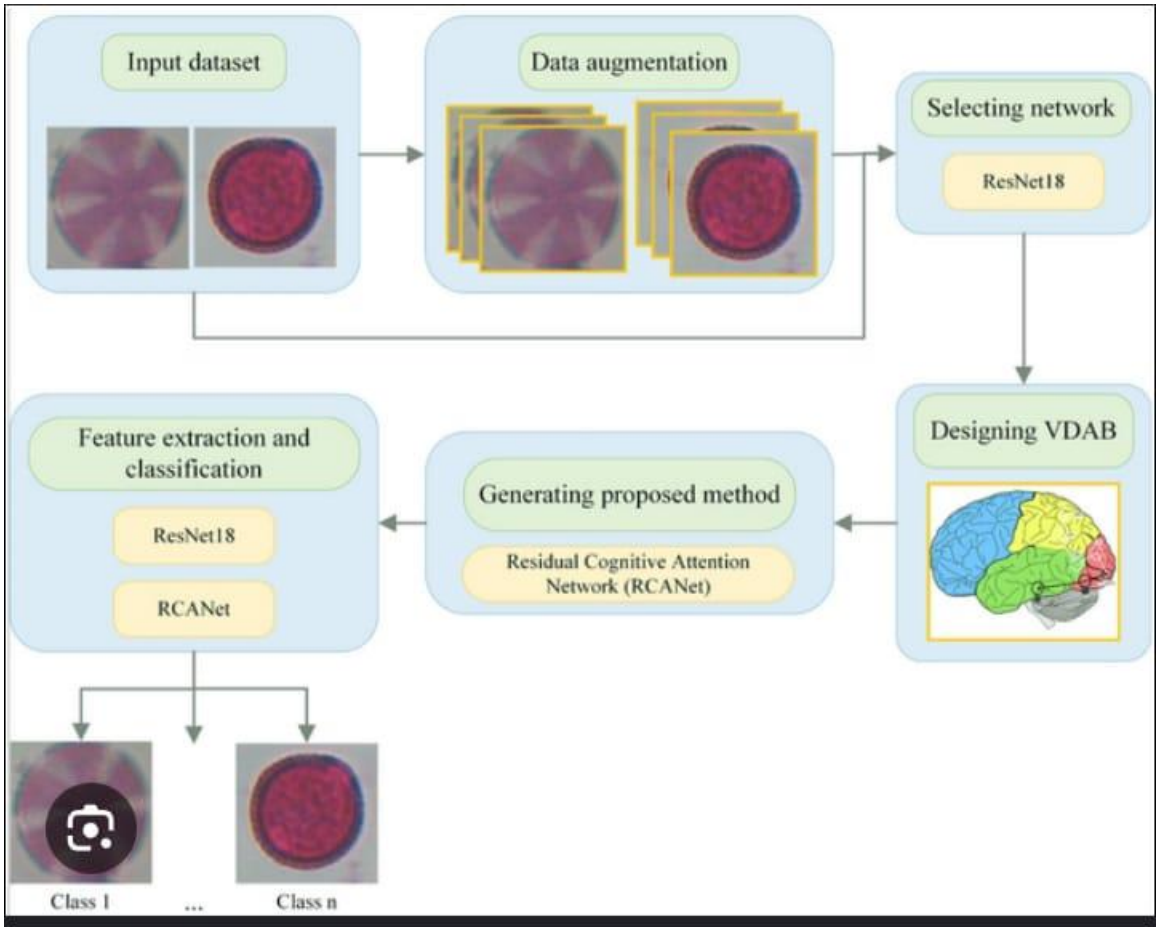
Cloud Storage Metadata Store Research DB

Benefits:

- Faster and more accurate pollen classification.
- Reduces dependency on expert palynologists.
- Helps in allergy forecasting, climate studies, and crop monitoring.


Input dataset
Data augmentation
Selecting network
ResNet18
Designing VDAB
Generating proposed method
Residual Cognitive Attention Network (RCANet)
Feature extraction and classification
ResNet18
RCANet
Class 1
...
Class n