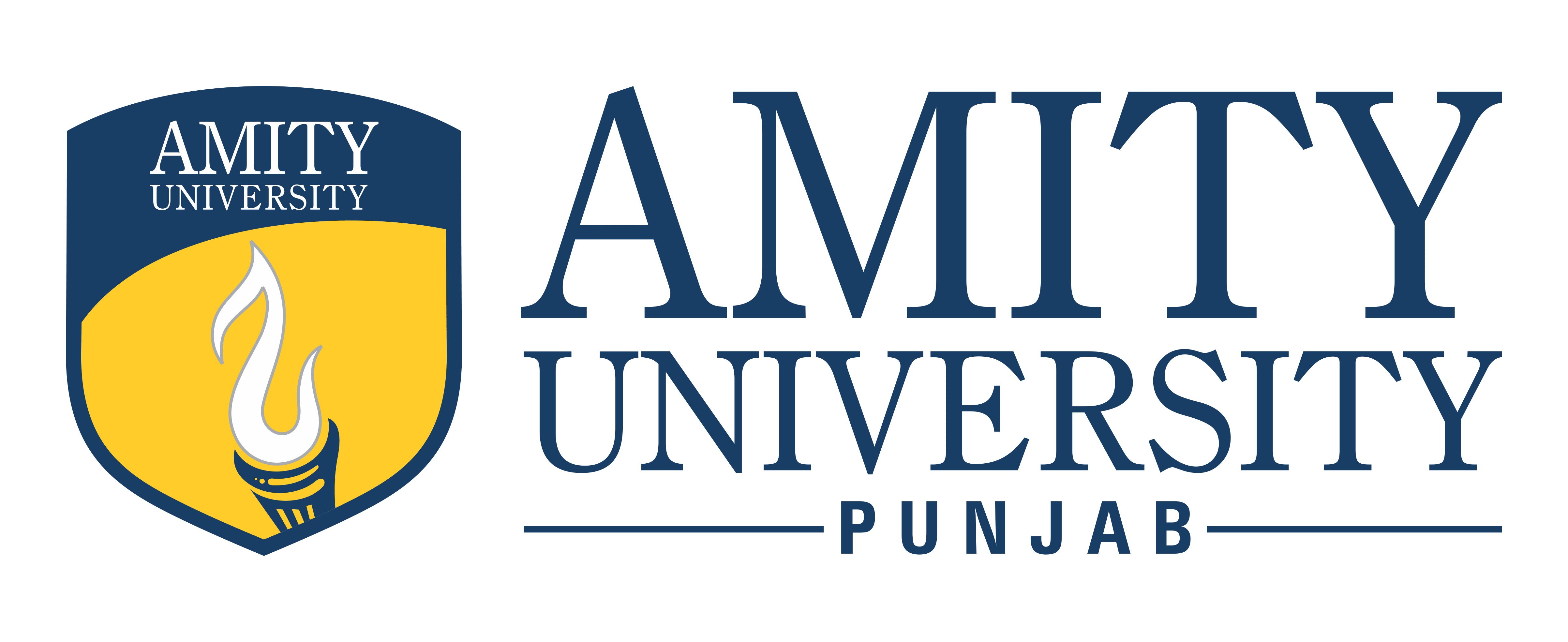
**PROJECT FILE**

**COMPILER DESIGN**

**CSE309**



**SESSION: 2022-2026**

**B. TECH-CSE-B**

**SEMESTER-6th**

**SUBMITTED TO: SUBMITTED BY:**

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**Project Title:**

Compiler for AI-Powered Smart Farming using Drone Images

* Uses Hybrid PSO + Ant Lion Optimizer (ALO) to compile drone-captured agricultural images into actionable insights.

1. **Key Features**
2. **Hybrid Optimization (PSO + ALO):**
   * Uses Particle Swarm Optimization (PSO) for global exploration and Ant Lion Optimizer (ALO) for local exploitation.
   * Ensures fast convergence with improved accuracy for processing drone images.
3. **Drone Image Processing for Smart Agriculture:**
   * Captures high-resolution images of farmlands for real-time analysis.
   * Segments crops, weeds, and soil patches using advanced deep learning segmentation techniques (e.g., U-Net, Mask R-CNN).
4. **Actionable Insights from Data:**
   * Identifies crop health status, weed presence, soil conditions, and yield prediction.
   * Provides insights for precision farming (e.g., fertilizer and pesticide optimization).
5. **Noise-Resistant Image Analysis:**
   * Handles low-quality images (blur, shadow, fog) using AI-driven image enhancement techniques.
6. **Optimized Drone Path Planning:**
   * Uses PSO + ALO to determine the most efficient drone path for surveying farmlands.
   * Minimizes fuel/energy consumption and maximizes coverage efficiency.
7. **Cloud & Edge Computing Support:**
   * Real-time processing with edge AI for low-latency decisions.
   * Cloud-based analytics for big data processing of multiple farm images.
8. **AI-Driven Disease and Pest Detection:**
   * Identifies plant diseases and pest infestations using CNN-based models trained on agricultural datasets.
9. **Sustainable Farming Decision Support System:**
   * Suggests optimal irrigation schedules, harvesting times, and crop rotation strategies.
10. **Implementation Steps**

**1. Data Collection**

* Capture high-resolution drone images using UAVs (Drones).
* Gather metadata (GPS coordinates, temperature, soil conditions).
* Label datasets for crop health, weeds, pests, and diseases using agricultural experts.

**2. Preprocessing of Drone Images**

* Noise Reduction: Apply Gaussian Blur, Bilateral Filtering.
* Contrast Enhancement: Use CLAHE (Contrast Limited Adaptive Histogram Equalization).
* Segmentation: Use Deep Learning (U-Net, Mask R-CNN) to segment crops, soil, and weeds.

**3. Feature Extraction**

* Texture Features: Extract using Gray-Level Co-occurrence Matrix (GLCM).
* Color Features: Use HSV color model for disease detection.
* Shape Features: Identify plant health based on leaf shape anomalies.

**4. Optimization Using Hybrid PSO + ALO**

* PSO Stage:
  + Initialize particles with random positions (drone paths, segmentation regions).
  + Update velocity and position using PSO rules.
  + Select best particles for refinement.
* ALO Stage:
  + Use Ant Lion trapping mechanism to refine the best candidate solutions.
  + Balance exploration (PSO) and exploitation (ALO) for faster convergence.

5. **Model Training for Classification & Prediction**

* Train a Convolutional Neural Network (CNN) on preprocessed images.
* Use Transfer Learning (ResNet, VGG, EfficientNet) to improve classification accuracy.
* Train an LSTM model for time-series crop yield prediction.

**6. Fitness Function Design**

* Implement a multi-objective function:
* Optimize for **higher accuracy, lower time, and lower energy consumption**.

**7. Deployment & Real-time Processing**

* Deploy on Edge Devices (Jetson Nano, Raspberry Pi, TPU for real-time).
* Cloud storage for large-scale drone image analytics.
* Mobile App/Web Dashboard for farmers to view insights.

**8. Actionable Insights & Decision Support**

* **Disease Detection:** Alert farmers about infected crops.
* **Yield Prediction:** Recommend best harvesting times.
* **Drone Path Optimization:** Suggest **optimal UAV paths for surveying fields**.

1. **Performance Parameters**
2. **Performance Parameters in Tabular Form**

| **Parameter** | **Definition** | **Measurement Method** |
| --- | --- | --- |
| **Accuracy of Image Classification** | Measures how well the model classifies crops, diseases, and soil conditions. | Precision, Recall, F1-score from a confusion matrix. |
| **Optimization Convergence Speed** | Evaluates how fast the Hybrid PSO+ALO finds the optimal solution. | Number of iterations required to reach an optimal threshold. |
| **Computation Time** | Time taken to process drone images and generate insights. | Execution time in seconds/milliseconds per image. |
| **Energy Efficiency** | Assesses the power consumption of the AI model during processing. | CPU/GPU power usage in watts per inference. |
| **Segmentation Efficiency** | Measures how well the algorithm segments crops, weeds, and soil features. | Intersection over Union (IoU) between predicted and actual segments. |
| **Path Planning Efficiency for Drones** | Evaluates the effectiveness of the optimized path for drones using AI. | Distance covered vs. optimal path ratio. |
| **Robustness to Noisy Data** | Checks how well the model handles low-quality images (blur, shadows, etc.). | Accuracy drop (%) when noise is added to input images. |
| **Memory Usage** | Determines the memory required to execute the algorithm efficiently. | RAM consumption in MB/GB. |
| **Crop Health Prediction Accuracy** | Measures how well the system predicts crop health status. | Correlation (%) with ground truth field reports. |
| **Yield Prediction Accuracy** | Evaluates the precision of AI-based yield estimation. | Mean Absolute Percentage Error (MAPE) between predicted and actual yield. |

**5. Graphical Representation of Performance Metrics**

1. **Radar Chart:**

* Compares multiple performance metrics such as accuracy, efficiency, and energy consumption.
* **Axes:** Accuracy, Computation Time, Energy Efficiency, Robustness, Memory Usage.

2. **Heatmap Analysis:**

* Visualizes parameter impact based on input variations.
* **X-Axis:** Different noise levels, **Y-Axis:** Classification Accuracy.

3. **Convergence Graph:**

* Shows how quickly PSO + ALO optimizes the function.
* **X-Axis:** Iterations, **Y-Axis:** Fitness Score.

4. **Histogram (Image Processing Time Distribution):**

* Shows processing time variation across different images.
* **X-Axis:** Time intervals, **Y-Axis:** Number of images processed.

5. **Drone Path Efficiency Visualization:**

* Displays the optimized vs. non-optimized drone path overlaid on an agricultural map.

**6. Innovative Fitness Function for Hybrid PSO + ALO**

The fitness function for evaluating the AI-powered smart farming system should be multi-objective, combining accuracy, energy efficiency, and processing time to ensure an optimal balance between performance and resource utilization.

**Explanation of Parameters:**

* α,β,γ\alpha, \beta, \gamma are weighting factors that determine the importance of each component.
* Accuracy: Measures how well the model classifies and processes agricultural data.
* Time Taken: Represents the computational time required for image processing and analysis.
* Max Time: The highest allowable time limit for processing.
* Energy Used: The power consumption of the AI model during execution.
* Max Energy: The maximum allowable energy consumption.