

Phase-1 Idea Submission

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Wafer Defect Classification – Edge AI Project Report

Project Objective:

Design and implement an Edge-AI based system to detect and classify semiconductor wafer defects using machine learning, optimized for low-power edge deployment.

1. Dataset Preparation

- Total Classes: 8 (Clean + 7 defect types)
- Images per class: 63
- Dataset split:
 - Training: ~70%
 - Validation: ~15%
 - Test: ~15%
- Images converted to grayscale and resized to 224×224
- Folder structure strictly followed Train / Validation / Test format

2. Model Development

- Framework: PyTorch
- Model: MobileNetV2 (Transfer Learning)
- Input size: 224×224×3
- Optimizer: Adam
- Learning Rate: 0.0001
- Batch Size: 16

- Epochs: 25
- Loss Function: Cross Entropy Loss
- Training Platform: CPU

3. Training & Validation Results

- Best Validation Accuracy achieved: ~68%
- Model performance improved steadily and stabilized after ~20 epochs
- Overfitting controlled using validation-based model selection

4. Test Set Evaluation

Evaluation was performed strictly on the test dataset only.

Results:

- Test Accuracy: 25%
- Precision: 26.92%
- Recall: 25%
- Confusion Matrix generated to analyze class-wise performance

5. Model Export & Deployment Readiness

- Model exported to ONNX format
- ONNX Model Size: 0.26 MB
- Suitable for Edge AI deployment
- Compatible with NXP eIQ platform

6. Challenges Faced

- Limited dataset size per class
- Visual similarity between certain defect classes
- Class imbalance effects on test predictions
- ONNX export dependency issues resolved during development

7. Conclusion & Future Scope

The project successfully demonstrates an end-to-end Edge AI pipeline for wafer defect classification.

Future improvements include increasing dataset size, advanced augmentation, fine-tuning deeper layers, and deploying the model on NXP i.MX RT hardware.