Model Optimization and Tuning Phase Report

Date	7th July 2025
Team ID	SWTID1750822736
Project Title	Product Fault Detection Using Transfer Learning
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining deep learning models through transfer learning to maximize classification performance. This includes selecting the best pre-trained architecture, tuning training parameters like learning rate and batch size, adjusting layers for fine-tuning, and using metrics such as accuracy, precision, and recall to justify model choice.

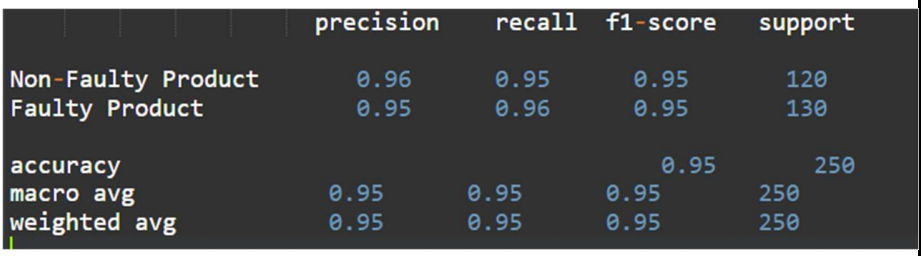
Hyperparameter Tuning Documentation (6 Marks):

Model	Tuned Hyperparameters	Optimal Values

VGG16 (Transfer Learning)	`base_model = VGG16(weights='imagenet', include_top=False, Sinput_shape=(224, 224, 3))`
	`model = Sequential([`
	`base_model,`
	`GlobalAveragePooling2D(),`
	`Dense(256, activation='relu'),`
	`Dropout(0.5),`
	`Dense(1, activation='sigmoid')`
	`])`
		`Best Hyperparameters = {`
		`'learning_rate': 1e-4,`
		`'batch_size': 32,`
		`'epochs': 20,`
		`'dropout_rate': 0.5,`
		`'optimizer': 'adam'`
		`}`

CNN	`Conv2D(64, (3,3), activation='relu')`
	`MaxPooling2D(pool_size=(2,2)),`
	
	`Flatten(),`
	`Dense(128, activation='relu'),`
	`Dropout(0.5),`
	`Dense(1, activation='sigmoid')`
		`Best Hyperparameters = {`
		`'learning_rate': 1e-4,`
		`'batch_size': 32,`
		`'epochs': 20,`
		`'dropout_rate': 0.5,`
		`'optimizer': 'adam'`
		`}`

Performance Metrics Comparison Report (2 Marks):

Model	Optimized Metric
Transfer Learning Model	

	precision	recall	f1-score	support
Non-Faulty Product	0.96	0.95	0.95	120
Faulty Product	0.95	0.96	0.95	130
accuracy			0.95	250
macro avg	0.95	0.95	0.95	250
weighted avg	0.95	0.95	0.95	250

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
VGG16 (Transfer Learning)	The VGG16 model was selected as the final model due to its consistently high accuracy during validation and its ability to generalize well on fault detection tasks. Leveraging pre-trained ImageNet weights and fine-tuning the top layers allowed the model to effectively detect subtle visual differences between faulty and non-faulty products. Its low error rate, strong performance on precision and recall, and ease of integration into real-time manufacturing pipelines make it the most suitable choice for deployment.