PROACTIVE PACKAGE DAMAGE DETECTION USING AI

BDA – GROUP 22

MEET THE TEAM

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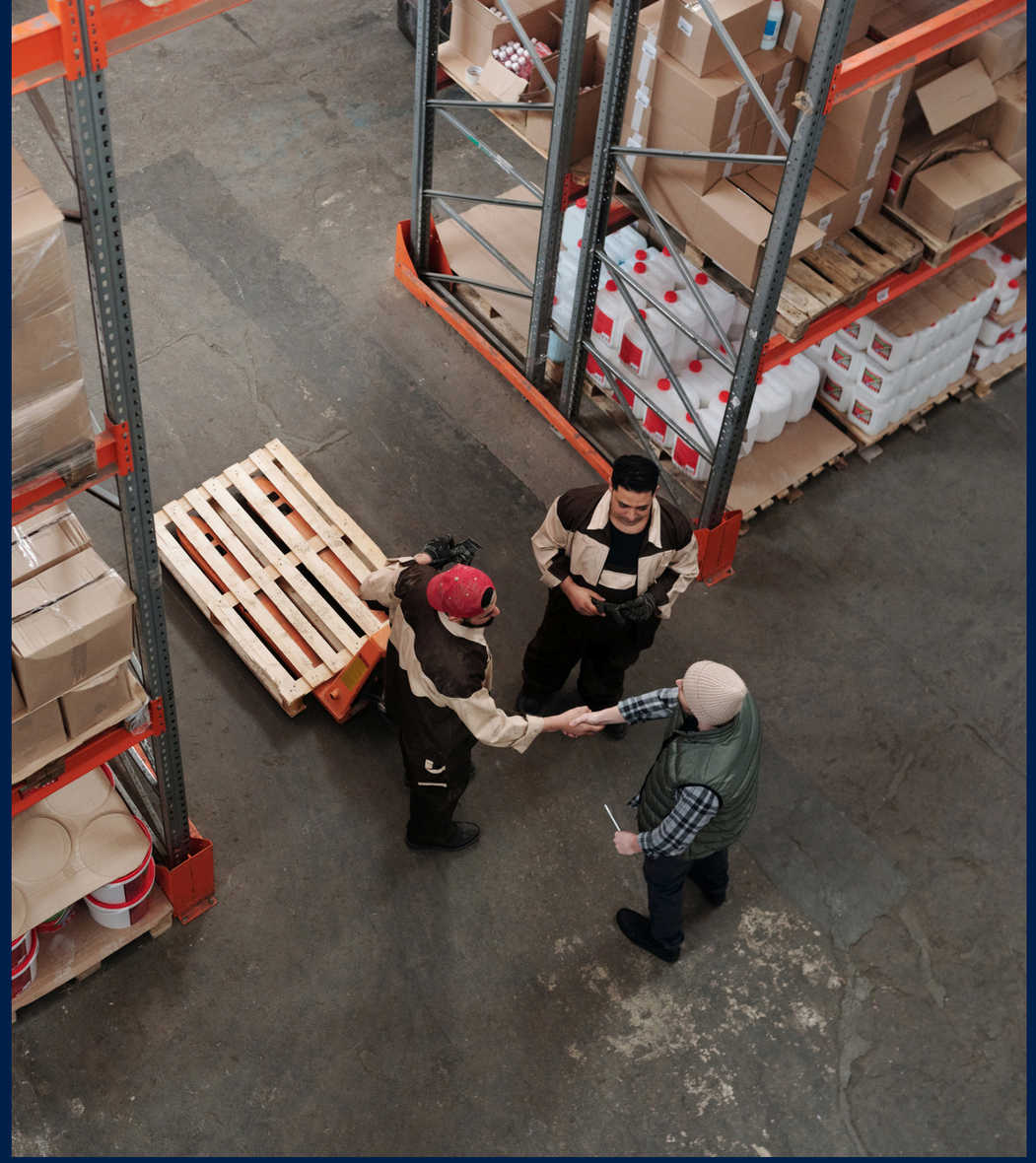
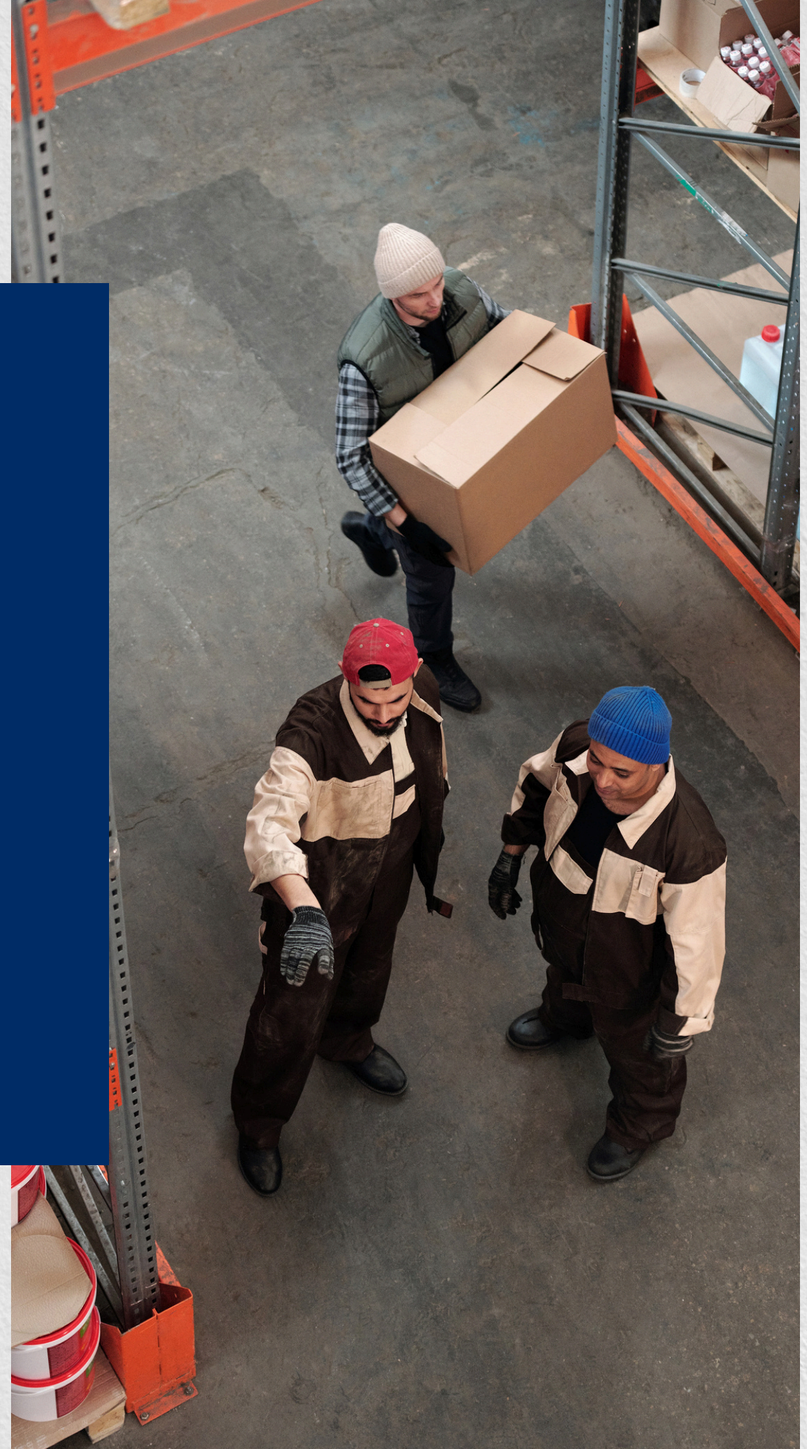


Business Problem

- DAMAGED PACKAGES ARE IDENTIFIED TOO LATE — AFTER DELIVERY.
- RESULTS IN CUSTOMER DISSATISFACTION, RETURN COSTS, AND BRAND DAMAGE.
- MANUAL INSPECTION IS INEFFICIENT AND INCONSISTENT.

Our Initiative



- USE AI-BASED IMAGE CLASSIFICATION TO DETECT PACKAGE DAMAGE BEFORE SHIPPING.
- STAFF CAPTURES A PHOTO AT THE DISPATCH STAGE.
- MODEL FLAGS PACKAGES AT HIGH RISK FOR MANUAL INSPECTION AND REPACKAGING.

Dataset and Tools

- **DATASET:** 'DAMAGED AND INTACT PACKAGES' FROM KAGGLE (~1,000 IMAGES)
- **CLASSES:** 'DAMAGED' VS 'INTACT'
- **TOOLS:** GOOGLE COLAB, TENSORFLOW, KERAS, GRAD-CAM, SCIKIT-LEARN

Model Pipeline

ARCHITECTURE:
MOBILENETV2 (TRANSFER LEARNING)

IMAGE SIZE:
224X224, NORMALIZED RGB

RISK SCORING:
PROBABILITIES CONVERTED TO 0–100%

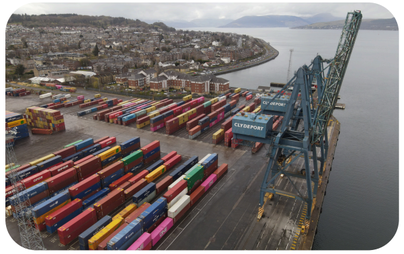
OUTPUT:
SIGMOID (BINARY CLASSIFICATION)

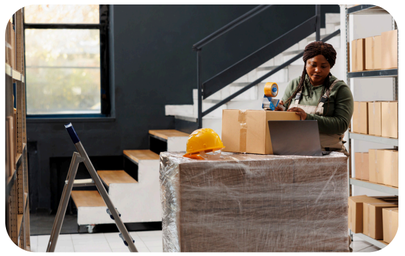
TRAIN/TEST SPLIT:-
TRAINING SET: 462 IMAGES (80%)
TEST SET: 120 IMAGES (20%)

TOTAL IMAGES: 582

CLASSES: 2 (DAMAGED, INTACT)

Model Performance

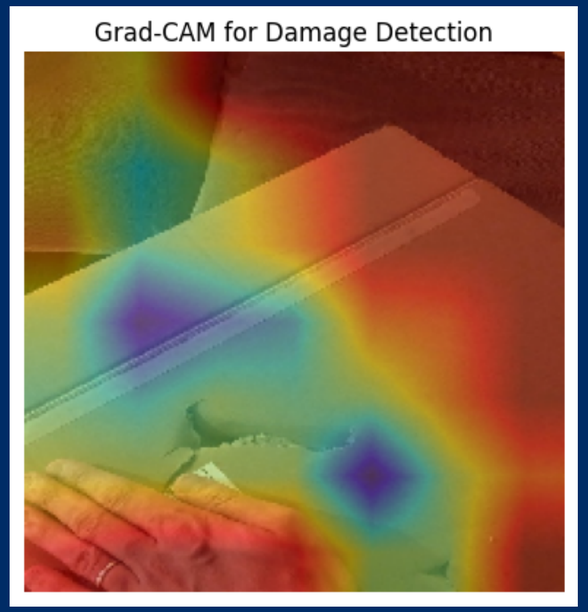


- VALIDATION ACCURACY: 85.83%
- CLASSIFICATION REPORT:
- DAMAGED F1 SCORE: 0.44
- INTACT F1 SCORE: 0.47
- CONFUSION MATRIX: 26 DAMAGED / 29 INTACT CORRECTLY PREDICTED

Model Explanation – Grad-CAM

- GRAD-CAM HIGHLIGHTS IMAGE INFLUENCING PREDICTIONS.
- HELPS STAFF INTERPRET MODEL OUTPUTS.
- BUILDS TRANSPARENCY AND TRUST.



Risk Scoring

- CONVERTS MODEL PROBABILITY TO INTERPRETABLE RISK SCORE.

- EXAMPLE:
  1. IMAGE 1: 72.83% → DAMAGED
  2. IMAGE 2: 43.11% → INTACT

- THRESHOLDS ALLOW ACTION/ALERTS.

SAMPLE OUTPUT

Pred: Intact | Actual: Intact

Pred: Damaged | Actual: Damaged

Pred: Damaged | Actual: Damaged

SAMPLE OUTPUT

Business Impact

- **REDUCES** REVERSE LOGISTICS COSTS.
- **IMPROVES** DAMAGE-FREE DELIVERY RATES.
- **REINFORCES** BRAND IMAGE AND TRUST.
- **ENABLES** DATA-DRIVEN PACKAGING IMPROVEMENTS.

Challenges & Next Steps

Challenges

- LIMITED DATASET, IMBALANCE IN DAMAGE CLASS
- REAL-WORLD LIGHTING/ANGLES MAY VARY

Next Steps

- GATHER WAREHOUSE-SPECIFIC DATA
- FINE-TUNE MODEL AND TEST IN LIVE ENVIRONMENTS
- EXPLORE ANOMALY DETECTION MODELS


Thank You.
LET'S SHIP SMARTER, NOT HARDER!
QUESTIONS?