Task-1: Related Work

Surface Crack Detection Domain

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1 Introduction

Surface crack detection is a critical problem in structural health monitoring, civil infrastructure inspection, and automated quality assessment. Traditional computer vision methods relied on handcrafted features such as edge detection and thresholding, which are sensitive to illumination variation and background noise.

Deep learning, particularly Convolutional Neural Networks (CNNs), has significantly improved crack classification performance. Transfer learning from ImageNet-pretrained models is commonly adopted due to limited dataset size.

The Py-CrackDB dataset contains 504 cleaned images after duplicate removal, with two classes (With Crack / Without Crack) and moderate class imbalance.

2 Related Work Summary

Title	Dataset Name & URL	Dataset Description	Methods	Acc.	Pros	Cons	Citation
Concrete Crack Detection Using Deep CNN	SDNET2018	56,000+ images; binary crack classification; multiple surface types	ResNet-50	98–99%	Strong feature extraction; robust generalization	High computation cost	Dorafshan et al., 2018
Automated Pavement Crack Detection	CFD Dataset	118 images; crack segmentation and classification	VGG-16	91–95%	Simple transfer learning pipeline	Small dataset; overfitting risk	Zhang et al., 2016
Lightweight Crack Classification Study	AEL Surface Dataset	∼2000 images; binary classification	MobileNetV2	94–97%	Low GFLOPs; deployment efficient	Slight recall drop in complex textures	Applied studies
EfficientNet for Crack Detection	SDNET2018	56k+ images; balanced classes	EfficientNet-B0	∼99%	High accuracy-to-parameter ratio	Sensitive to hyperparameter tuning	Tan and Le, 2019
Vision Transformer for Structural Defect Detection	Large-scale crack datasets	Binary crack classification; high-resolution textures	ViT-B/16	97–99%	Strong global context modeling	Data-hungry; requires strong augmentation	Dosovitskiy et al., 2020

Table 1: Related Work Summary in Surface Crack Detection Domain

3 Backbone Selection Justification

The following supervised backbones are selected:

- ResNet-50
- ResNet-101
- MobileNetV2
- EfficientNet-B0
- Vision Transformer (ViT-B/16)

These models are widely validated in crack detection research and suitable for small-to-medium-scale datasets.

4 Research Gaps and Motivation

Although high accuracy is reported in prior works:

- Most studies evaluate only a single 80:20 split.
- Label-efficiency analysis is limited.
- SSL comparison is rarely performed.
- Statistical significance testing is often absent.

This project addresses these gaps through structured benchmarking and SSL comparison under reproducible settings.

References

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