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Classifying Crack Types on Masonry Surfaces with Artificial Intelligence & Image Processing

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ABSTRACT

A large number of building structures are built based on masonry in the world. Due to natural causes, mediocre construction or external forces inevitably cracks will occur. Present, these cracks are observed and analysed manually. Since the results will depend on the expert's experience and human errors can affect the accuracy. Compared to solutions that are implemented for other surfaces using computer vision to classify crack types and analyse severity, less focus was given to masonry structures. It’s better if the defect is identified early and mitigated before its severity hikes and causes deathly accidents.

This research classifies the masonry wall crack types and analyses the severity of that type from a mobile application. In addition, a dataset that is suitable to classify crack patterns formed by gathering from various locations along with certification of a civil engineer. The model trained on masonry image patches using the MobileNet algorithm with transfer learning. Weights trained on the ImageNet dataset were used in the model. Then fine-tuning technique was utilized by training only the batch normalization and custom layers of the model, meanwhile freezing the MobileNet layers. The last layer of the model is ignored and custom layers were added. Dropout layers of 0.5 were added before and after the dense layer. The dense layer was defined with a rectified linear activation function. Next, it’s passed to a Softmax activation layer for classification. Augmentation methods such as rotations had made the model accurate for 10^0 degrees for clockwise and anticlockwise. Pre-processing techniques such as resizing and enhancements were employed to make the prediction more accurate and quicker. Adamax optimizer was used along with sparse categorical cross-entropy as the loss function. Embedding the TensorFlow Lite model to the mobile has shown an optimal performance as it runs locally. An accuracy of 85% was achieved for the model. And respective F1 scores were achieved for flexural cracks at 87%, non-cracked at 88%, shear cracks at 84% and torsional cracks at 80%.

Keywords:– Masonry Crack Detection, Computer Vision, Transfer Learning, Convolutional Neural Network, Mobile Detection

Subject Descriptors:–

Computing Methodologies → Artificial Intelligence → Computer vision

Computing Methodologies → Machine Learning → Machine Learning Approaches → Neural Networks