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Grad-CAM for Explainable AI (XAI) in CNN-Based Drilled Hole Classification in Melamine Faced Chipboard

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In the furniture industry, precision in drilling holes in melamine-faced chipboard is crucial to maintaining product quality and minimizing financial losses. Manual monitoring of drill conditions, while somewhat effective, is inefficient and imprecise. This paper presents a Convolutional Neural Network (CNN) based approach for automated tool condition monitoring (TCM) using Gradient-weighted Class Activation Mapping (Grad-CAM) for Explainable AI (XAI). By leveraging the VGG16 pretrained network, we classify the condition of drilled holes into three categories: Green, Yellow, and Red. Grad-CAM provides visual explanations for the model's predictions, enhancing the transparency and reliability of the system. Our method improves the interpretability of the CNN model, identifies potential issues, and ultimately boosts the effectiveness and trustworthiness of automated TCM systems. The proposed approach shows significant potential for industrial applications, where understanding the decision-making process of AI models is as critical as their accuracy.

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