Improving Makerspace Accessibility by Leveraging Side Channel Data from Machining

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Abstract:

CNC machining is integral to the manufacturing industry when making complex parts with high accuracy. Because of their importance to manufacturing, CNCs are an important resource for makerspaces, which provide equipment and tools to a user base for working on projects. However, for inexperienced users, the CNC machine can be a daunting piece of equipment to learn. The cutting parameters are specific to the material being used and the project it's being used for, which creates a large learning curve for those approaching the CNC for the first time. The consequences improper operation can range from damage to the machine or workpiece to injury to the user or bystanders. Therefore, classifying the machine's use and providing feedback on that use to the user would reduce the barrier to entry for those trying to learn the CNC. To accomplish this, a ML model was developed to take in side channel data from drive axis and spindle power sensors built in to the EMCO E350 CNC and characterize the cut run as conservative, optimal, or aggressive. Several models were compared by the area under the receiver operating characteristic curves (AUROC), with a logistic regression approach proving most effective for a makerspace application, where a wide variety of machining parameters are used for different projects. Logistic regression had a score of 0.785 in the aggressive regime, while the next nearest score was a 0.600. Proposed continuation of this research seeks to widen the applicability by extending the ML technology to milling machines without built-in sensors. Doing so would involve evaluating sensors and adapting the model to the revised setup. In doing so, a larger number of makerspaces can see the benefit of this ML technology, and by extension, more makerspaces can become more accessible to novice users.