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Advanced Fault Prediction and Parameter Calibration for injection machine produced Parts with Machine Learning, Computer Vision and Knowledge Graphs

One of the main objectives in TEAMING.AI project is to demonstrate how advanced machine learning models and knowledge graphs can be orchestrated through the TEAMING engine to enhance performance across a wide range of manufacturing tasks. The activities explained below are within the context of use case 1 "Transfer learning based robust quality inspection (for plastic injection sector)" led by the consortium member FARPLAS (FAR), who is one of the largest plastic part manufacturers in Turkey.

Plastic injection molding is widely used in various industries, and the quality of the products is mostly affected by the shop floor conditions and deviations in machine parameters. Inevitably, a small but significant fraction of manufactured parts end up not meeting the quality standards and need to be discarded as scraps. This quality assessment process is performed manually by process technicians, who perform visual inspection on the parts to detect faults such as scratches and flashes. Furthermore, after each fault, the machine parameters might need to be recalibrated, which requires extensive knowledge regarding recognition of patterns between faulty types and sensor readings.

TEAMING.AI partners ITU, WU, UMA and TUD co-develops various algorithms and software in the framework of TEAMING engine in order to enhance the performance of this use case through use of machine learning and knowledge graphs. In particular, the manual quality inspection system is replaced with a deep learning based computer vision algorithm, which is trained on thousands of images of plastic parts, and is able to detect and segment the faulty sections in parts with high accuracy. The exhaustive manual parameter calibration approach is in the process of being replaced by a hybrid approach that combines knowledge graphs (encode official guidelines and human experience in parameter calibration) and machine learning models (detect anomalies across multiple sensor readings). Overall, the developed system is expected to detect the faulty parts and calibrate the machine with much higher accuracy and efficiency.

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Figure 1: The visual fault detection software and hardware, operator view

Figure 2: The visual fault detection software and hardware, camera view

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