

In recent times, automated manufacturing has become especially common in factories. However, automation is not flawless, and mistakes are often made during the process. In products such as syringes, manufacturing defects that are not noticed could cause fatal injuries to a patient in a hospital environment. Therefore, it is essential for a check to be in place so that these defects can be identified. Using humans for defect detection is currently the industry standard, but employees can be costly and they can become fatigued after hours of scanning for defects. Instead, an image recognition neural network model can be implemented to efficiently and accurately find defects in real time during the manufacturing process. An important factor for the success of this model is the processing time. Especially in a manufacturing setting, defects must be found quickly. Therefore, the YOLO11 deep learning model was chosen as the detection system, as it is known for its fast inference time. Images of defective syringes were taken, and bounding boxes were used to annotate the defects present in those images. After training, the model was tested, and it was found to take around 1.72 seconds for inference and was 93% accurate in identifying most defects. Therefore, the model was a viable choice for syringe defect detection and can effectively prevent damaged syringes from ever reaching hospitals.

*Keywords: AI, CNN, Machine Learning, Syringe Defect, YOLO11, Ultralytics*