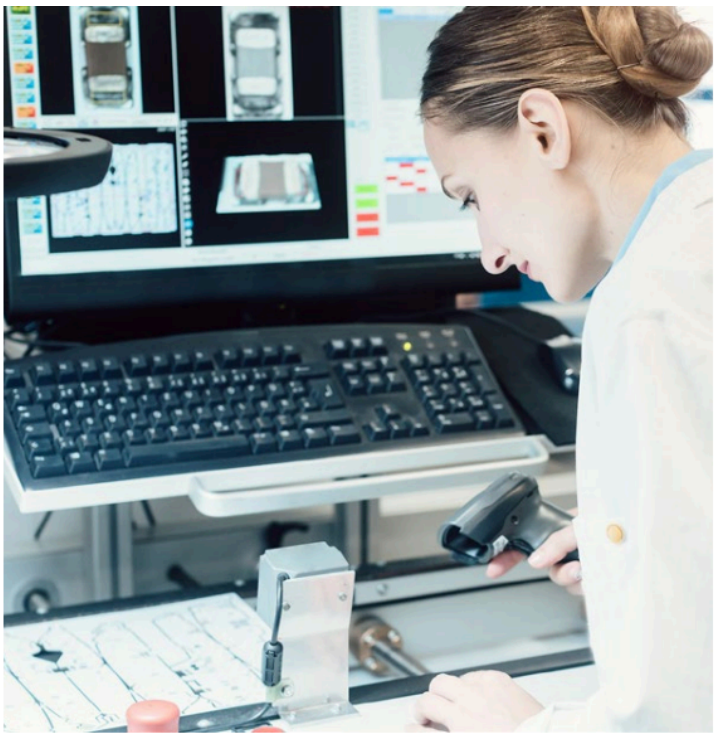
Counterfeit Mitigation by In-line Deep Visual Inspection



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Introduction The COVID-19 pandemic has caused supply chain disruptions and component shortages. The pandemic shut down many avenues for raw materials and bulk electronic components, leaving manufacturers with half-finished products and idle capacity. Allocations are forcing manufacturers to purchase components on the free market. This is increasing the risk of counterfeit, out-of-date1 , mixed lots, badly handled, recycled, and defective components, from the typical 0.5–1.5% when purchasing from trusted sources, to 5–10% of purchasing in the free market. While this risk is conventionally mitigated by performing sample lab tests on components purchased in the free market according to SAE AS6081, sampling only a small fraction of the components carries many risks2 . Lab testing does not address out-of-date, mixed lots, badly handled, tampered, or defective components which may be randomly scattered within a package.

In this work we show that all the evidence needed to deem components suitable for use exist on their external packaging. The packaging of components has subtle intrinsic features imprinted during the packaging process that serves as a "fingerprint" of the component manufacturer. Recycled components may undergo black topping, remarking, and repacking— all leaving visible evidence on the component's exterior. Cloned, overproduced and defective components are packaged using a different source, presenting a different package. Re-dating old components may be detected externally by the poor state of the leads. These subtle features may be used to authenticate components. We also present a novel method to estimate the apparent age, and as a result, the solderability of the component based on the optical surface of the soldering leads1 . The solderleads are the fastest aging part of the component, as it is made of a metallic compound that corrodes and decays by intermetallic interaction3 . As a result, lead condition is an excellent indicator of a component's apparent age, storage conditions, and handling conditions.