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Support Vector Machines-Based Abnormality Detection and Prediction in Stencil Printing Process

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Abstract: Surface mounting technology (SMT) is the main manufacturing process used in the electronics assembly industry. It is critical to improve the first-time-yield of printed circuit boards (PCBs) in an SMT assembly to save the manufacturing costs. The stencil printing process (SPP) is one of the main contributors to the SMT soldering defects. This research is motivated by enhancing the SPP from early detection and prediction of unnatural patterns in the deposited solder paste volume. A novel multi-stage predictive abnormality detection framework is proposed for the SPP. At the first stage, a support vector regression (SVR) based exponential weighted moving average (EWMA) control chart is developed to effectively monitor highly autocorrelated SPP system and identify the existing patterns. At the second stage, a support vector machine (SVM) predictive modeling is used to predict the occurrence of abnormal patterns before they arise based on several statistical features extracted from the control chart patterns (CCPs) using a moving window recognition approach. Once abnormal conditions are recognized, appropriate corrective actions can be taken to the SPP. The experimental results confirm the effectiveness of the proposed model architecture in early detection and prediction of the abnormal CCPs to prevent solder paste printing defects and reduce high reworking costs for large scale production.

Keywords: Stencil Printing Process, Support Vector Machines (SVMS), Regression Residual Control Chart, Abnormality Detection, Anomaly Prediction.