Visual Anomaly-Detection for Conveyor-Line Shuttles

Students

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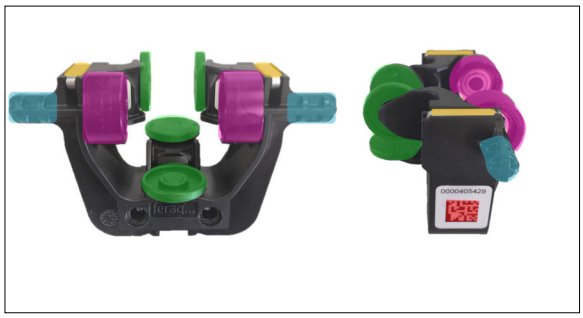
Introduction: This work focuses on the development and implementation of an image processing algorithm to determine the state (defective or operational) of shuttles on a conveyor system used for transporting goods in a warehouse. These shuttles, rolling on rails that are fixed to the ceiling and driven by a chain, are prone to damage, leading to production interruptions. Minimizing these interruptions is crucial. To achieve this goal, faulty shuttles need to be promptly detected and segregated. The most occurred damages are fallen off wheels, nubs or an unreadable Datamatrix.

Approach: Various approaches were explored, including the use of the SIFT algorithm to match shuttle features for correctness determination. While this approach appeared elegant and widely applicable with minimal calibration, experimentation revealed challenges in ensuring consistent and accurate results. Therefore, an alternative approach based on analyzing grey values in specific areas (where the wheels should be) emerged as promising, demonstrating robustness and accuracy. Using a camera connected to a Raspberry Pi for remote streaming of the images to a server makes the system wireless. Shuttles can be detected, their state determined, displayed, and exported for further analysis on a computer anywhere.

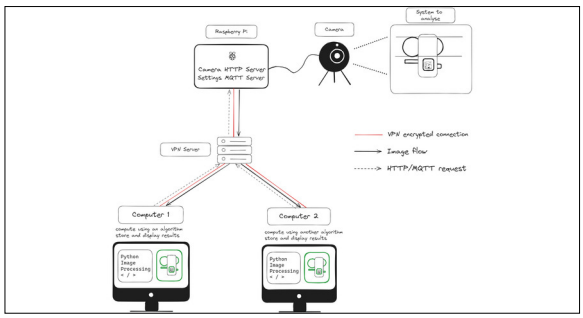
Result: Detecting defective shuttles is achievable and can be displayed and saved in real-time, with a processing rate of up to two shuttles per second (faster speeds couldn't be achieved by the system) and an accuracy of up to 1 in a thousand. The implementation of a Datamatrix reader enhances accuracy further for negative to positive detection, but its drawback lies in occasional disruptions to the workflow due to the time taken for Datamatrix code detection.

The developed algorithm demonstrates its ability to sort shuttles for validity, but refinements are possible for further enhancement. Future improvements include automating initialization and calibration, autonomously selecting interesting positions, eliminating the need for a new dataset after each calibration and achieving faster Datamatrix detection to prevent workflow disruption. Further more adjustments like implementing a more robust background subtractor for resistance to illumination variations and incorporating a feature to identify cracks in the wheel holder using contours or SIFT features could be included to have an even better output.

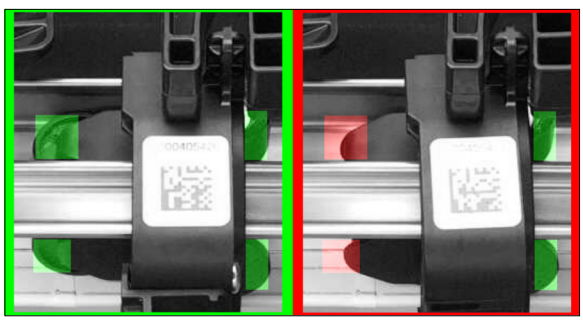
Shuttles with critical sections to analyse highlighted
Own presentment



Overview of the data flow
Own presentment



Example of result. No fault detected (left), defective shuttles with missing wheels (right)
Own presentment



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