High-Speed Industrial Sorting Mechanisms

Introduction

As the cost of automation reduces in comparison to the cost of human labor, manufacturers are turning towards replacing human workers with automated machines. [1] One prevalent area this change is happening is industrial sorting/categorization. This paper reviews types of high-volume and high-speed sorting mechanisms used for commercial applications.

Commercial Applications of High-Speed Sorting Systems

Food Industry

Due to the scale of food production, many products are available that manufacturers can use to sort their produce, by separating out items such as foreign material and animal matter from products that can be delivered to the consumer. Several products accomplish this goal, including the $22,800 TOMRA Sentinal II which is designed to do high speed, [2] high volume sorting of fresh food – particularly the tomato, peach, and potato industries. [3] Items move across a high-speed conveyor belt and are viewed by a system of cameras which are interfaced with a PLC (Programmable Logic Controller). After the conveyor belt ends, “Intelligent Finger Ejectors” (spaced at 0.25-inch intervals across the conveyor belt to ensure access to any item on it) interfaced with the PLC push the items into one of two bins (by either pushing or not pushing the object). Many of the components of the machine are removable, allowing a customer to easily clean the device. In addition, configurations using multiple rows of “Finger Ejectors” allow items to be categorized into more than 2 categories.

Sorting Waste

When garbage trucks collect waste and bring them to mixed-waste processing sites, waste goes through multiple stages of separation involving machines (such as using magnets) as well as human components to separate single stream waste into its respective waste categories. OEM Sherbrook offers a $32,000 optical sorter product that uses a system of NIR (Near Infrared Reflectance) cameras to

categorize waste products. [4] By shining a powerful light source onto the object and measuring the different wavelengths absorbed by each item, the machine is able to identify different types of plastics (including PET, HDPE, and PVC) and fibers. [1] According to the libraries used and the user configurations, [5] once the item reaches the end of the conveyor belt it is on, it is separated into different bins by changing the shutter values for a span of air jets. By adjusting these shutter values, the machine can handle objects of varying size and mass.

Technologies being used

Although there are several ways that manufacturers are physically separating items, including the previously mentioned air jets and mechanical ejectors, the use of cameras and other optical sensors to identify and classify items are common. Material travels at high speed and is imaged by cameras oriented in a tilted-X configuration, this configuration is used since it allows the leading edge and trailing edge to be viewed. [6] Depending on the optical sensor used, the input data is collected and transferred to an image processing board which carries out normalization, color segmentation, filtering and object feature extraction. Based on the application different features are used, for instance, color may not be the only factor if different sorting categories are the same color. The distance between the optical inputs and the sorting mechanism (between the cameras and air jets in the case of the TOMRA Sentinal II [2]) and time taken for items to move from one to the other have to be considered to ensure maximum reliable throughput.

Building blocks

High-speed high-volume object sorting mechanisms have two major components: item categorization and item separation. Item categorization can be done through processing images from cameras and then extracting distinguishing features, [6] or doing spectral analysis on the objects. [5] These are interfaced with image processing boards, a central controller, and the sorting mechanism. Possible sorting mechanisms range from mechanical “finger ejectors” to air jets.

Works Cited

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