Design and Development of 5-DOF Color Sorting Manipulator for Industrial Applications

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Abstract—Image processing in today's world grabs massive attentions as it leads to possibilities of broaden application in many fields of high technology. The real challenge is how to improve existing sorting system applications which consists of two integrated stations of processing and handling with a new image processing feature. Existing color sorting techniques use a set of inductive, capacitive, and optical sensors to differentiate object color. This research presents a mechatronic color sorting system solution with the application of image processing. A 5-DOF robot arm is designed and developed with pick and place operation to act as the main part of the color sorting system. Image processing procedure senses the circular objects in an image captured in real time by a webcam fixed at the end-effector then extracts color and position information out of it. This information is passed as a sequence of sorting commands to the manipulator that has pick-and-place mechanism. Performance analysis proves that this color based object sorting system works accurately under ideal condition in term of adequate illumination, circular objects shape and color. The circular objects tested for sorting are red, green and blue. For non-ideal condition, such as unspecified color the accuracy reduces to 80%.

Keywords—Robotics manipulator, 5-DOF manipulator, image processing, Color sorting, Pick-and-place.

cameras, computers, controllers for controlling the machines and sophisticated tools image processing has become the most powerful emerging technology.

Image processing is basically improving and enhancing the images taken in daily life using cameras considered as vision sensors for various applications. In the last few decades different techniques have been developed for detecting the objects using vision systems. Color histograms were first proposed by Swain and Ballard [1] as a first approach for object recognition. Other features such as orientation, gradient magnitude were added to the histograms by Schiele and Crowley [2]. These inventions helped in changing the rotation, direction and deformation but did not help in object recognition. Schneiderman and Kanade [3] were the first to introduce categorization of objects in natural scenes using wavelet transform coefficients. Wavelet transforms decompose the image into a group of salient features wavelet transforms by reducing the redundancy of the pixels. When relationship between the parts of the object is considered rather than just the appearance, the most complex methods are used. Part based representation of objects detected in gray images was developed by Agarwal et al. [4].