Camera orientation determination based on copper wire spool shape

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ABSTRACT
A simple and inexpensive system but effective in performing required tasks is the most preferable in industry. In this study, a vision system is developed to solve the peg-in-hole problem of a robot-like forklift to pick up copper wire spool arranged side by side on a rack, without using any sensors, except a low-cost camera. Inspired by how human perceive an object orientation based on its shape, an algorithm is developed to determine robot orientation based on the shape of a copper wire spool relative to camera position and yaw angle. The center point of the spool (CPS) should be on the center line of camera FOV (CFOV) if the camera is perpendicular or 0° parallel to the spool. Thus, the coordinate of the CPS and the CFOV is same. Instead, when the camera is seeing the spool from the angle less or bigger than 0°, the CPS and CFOV will be different, and the difference shows the position and the yaw angle of the camera relative to the spool. A copper wire spool has three circles; the outer circle, the tapper part around its center hole and the center hole itself. The proposed system uses Circular Hough Transform (CHT), filtering, binary, morphology and Sobel edge detection of the sampled images from real-time video recording to determine the orientation of the camera related to the copper wire spool shape, in which the center coordinate of the three circles was determined. Results from the experiments that had been done show that the system is able to determine the orientation of the camera related to the spool.

KEYWORDS
Circe detection; Copper wire spool; Camera orientation; Vision-based system

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