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Indoor localization based on monocular vision and color signature identification

C.S. Silva*

Department of Instrumentation and Automation Technology, University of Colombo, Sri Lanka

Localization is a process to find a relative location and orientation which enables to trace the position of objects or human beings in an unknown or complex environment. Although GPS (Global Positioning System) is ideal for outdoor navigation, it is untrustworthy in internal spaces because there is no visual contact with the satellites. The challenge of indoor localization has been addressed by utilizing existing infrastructure or adding additional infrastructures. Landmark-based color signatures (codes) that are deployed onto the indoor can estimate the position with a high level of accuracy. Color signature improves detection accuracy by decreasing false detections since unique color codes are attached to the predefined indoor locations. This work aims to investigate a low-cost positioning system using monocular vision and color signature identification. The CMUcam5 Pixy2 is a vision sensor with an onboard internal image processor. It can be configured to track one or multiple colors, such as color codes in the range of its vision using its built-in color-based filtering algorithm called Color Connected Components (CCC). Pixy provides the location coordinate of the center of the color code in camera coordinates in pixels. However, the requirement is to determine the location coordinates in the world coordinate system. Therefore, it is necessary to transform the location coordinates obtained as pixel coordinates through image coordinates to world coordinates. Calibration is performed to obtain intrinsic and extrinsic parameters of the camera necessary for the coordinate transformations. The extrinsic parameters represent a rigid transformation from the 3-D world coordinate system to the 3-D camera's coordinate system. The intrinsic parameters represent a projective transformation from the 3-D camera's coordinates into the 2-D image coordinates. Non-blurry images of the check board patterns are used for the calibration process. The estimation results show the positioning accuracy ranging from 0.067 cm to 3.15 cm for the y-coordinate and 0.0133 cm to 1.45 cm for the x-coordinate.

Keywords: Localization, vision, color code, coordinate transformation, calibration

E-mail: chathurika@iat.cmb.ac.lk