

# 移動式機器手臂搬運系統設計

## Design of Mobile Manipulator Systems for Object Transportation

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### 摘要

本文之研究目標為設計具視覺功能之移動式機械手臂之物體搬運系統，此系統包含單鏡頭深度計算、移動式機器人平台控制、6 軸機械手臂運動控制以及整合樹莓派與 Arduino 之數位平台等。有別與多數研究採用具深度感測元件之影像感測器，本文使用單價低且易取得之一般影像感測器，透過分析可以獲得機器人與物件之距離以及位置，接著計算所得之物件於空間中的相對座標後，經由移動式機械手臂平台之運動學模型計算獲得各軸馬達的控制命令，進而精準的抓取目標物件並運送至指定位置。本研究所設計之系統可擴展至兩具移動式機械手臂完成物件協同搬運任務。由實驗結果可看出本研究所開發之移動式機械手臂物體搬運系統能成功完成指定物件夾取與搬運，當待搬運之物件超過乘載負荷時，亦能傳送命令通知第二具機器人協同搬運。

關鍵字：機械手臂車、合作控制、運動學

### Abstract

The aim of this paper is to develop a mobile manipulator system for object transportation, where the developed system contains a monocular vision system, a mobile robot system, a six-axis manipulator system, and a Raspberry Pi - Arduino development system. First, the monocular vision system captures the vision and calculates the position including depth of object. Then, the control actions of the AI-motors in the mobile manipulation system can be obtained by the predesigned kinematic model using the relative positions which is from vision system. Finally, the task of the object transportation can be achieved. Moreover, the developed system can be extended to overcome the cooperative transportation tasks. From the experimental results, we can know that the object transportation tasks can be accomplished by the proposed mobile manipulator system.

Keywords: Manipulators, Mobile robot, Cooperative control.