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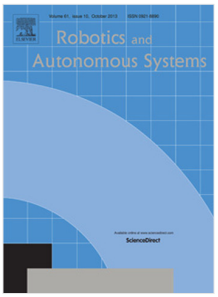

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Harmony Search Path Detection for Vision Based Automated Guided Vehicle

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Abstract

Efficient, cost effective, and fast automated guided vehicles (AGVs) are getting more an more attention day by day. Giant industries and huge businesses has already adopted the AGV technology to boost their profits. In order to make the AGVs more affordable for medium or small businesses, manufacturing costs must be reduced. A line follower AGV is a cost effective solution among the others. A line follower usually follows a painted line on the floor that guides it to its destination. Line followers generally avoid high cost line detection algorithms because of limited computational power. As the processors getting faster, cheaper, and smaller the question arises: is it possible to utilize costly algorithms such as evolutionary algorithms in such a real-time application? In this paper, a novel technique is presented for applying harmony search evolutionary algorithm in real-time line detection vision based and the idea was implemented using a two wheeled robotic platform. Proposed robot detects and follows the path with high levels of accuracy, without the need for edge detection and independent of image resolution.

Keywords: Harmony Search, Line Follower, Machine Vision, Line Detection, Automated Guided Vehicle.

1. Introduction

Throughout human history, transportation was always considered a challenge for humankind. The need for transporting heavy materials led to many innovations in the transport industry. Creation of man operated machinery was a giant step in transportation systems, which not only revolutionized transportation sector but all aspects of human life. Though man controlled transportation machinery lifted the burden of heavy transportation, human error in operation and control caused numerous accidents in which property and human lives were lost. With the dawn of robotics, researchers considered automated transport systems in order to reduce human error related risks. Nevertheless, designing an autonomous self-aware system capable of completing tasks on its own in every environment, still poses a great challenge to date. So instead of designing a fully autonomous system, Automated Guided Vehicle (AGV) concept were introduced in early 50's (Kelly et al., 2007).

An AGV is simply a robot that pursues any symbol or wire in the ground, or utilizes machine vision, magnetic field or laser guidance for navigation. They are usually used in industrial environments and warehouses to do the heavy lifting. Time and cost efficient transportation along with significant risk reduction, integrated AGVs in various industries like medicine, metal, manufacturing plants, and publishing (Schulze and Wullner, 2006).

Robotics is an interdisciplinary science, therefore there are so many challenges in every aspect of AGV design. Many researchers with diverse backgrounds are contributing to alleviate these obstacles. For instance, accurate positioning of an AGV has great importance when it comes to safety, so an RFID antenna along with a positioning system were proposed in order to facilitate accurate positioning of AGVs (Lu et al., 2016). Also path planning becomes a serious issue when multiple AGVs are working in the same space. Avoiding collisions and efficient delivery requires a global coordination system. Attempts were made to decentralize the global path planning system in order to overcome unpredicted circumstances (Draganjac et al., 2016).

Another example is utilization of AGVs for container transport and management in large ports. To improve efficiency and reduce the costs of the port management systems, an automated multi-story frame bridge system were suggested (Zhen et al., 2012). Learning the transportation tracks inside a work area from a human guide has been studied in another work. The robot tries to learn from a human teacher how to memorize and follow certain pathways. Their algorithm uses Gaussian Mixture Model to predict next move based on previous moves and Hidden Markov Model to derive a general solution from demonstrations (Vuković et al., 2015).

Another instance of AGV design challenge is providing a multi-agent model for industrial environments. There are researches around using paradigms inspired by nature for this task. Some approaches mimic behaviors of bees or ants in order to achieve collective control from simple AGV

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