International Journal of Internet, Broadcasting and Communication Vol.10 No.4 70-74 (2018)
http://dx.doi.org/10.7236/IJIBC.2018.10.4.70

IJIBC 18-4-11

A Study on Ceiling Light and Guided Line based Moving Detection Estimation Algorithm using Multi-Camera in Factory

Ki Rhyoung Kim[1†], Kang Hun Lee[1], Su Hyung Cho[2]

[1]SEIL Technology Co., Ltd., [2]Hans ENS Co., Ltd.
[†]{kris, wingslee}@seiltnn.com, silverki@hansmentor.com

Abstract

In order to ensure the flow of goods available and more flexible, reduce labor costs, many factories and industrial zones around the world are gradually moving to use automated solutions. One of them is to use Automated guided vehicles (AGV). Currently, there are a line tracing method as an AGV operating method, and a method of estimating the current position of the AGV and matching with a factory map and knowing the moving direction of the AGV. In this paper, we propose ceiling Light and guided line based moving direction estimation algorithm using multi-camera on the AGV in smart factory that can operate stable AGV by compensating the disadvantages of existing AGV operation method. The proposed algorithm is able to estimate its position and direction using a general - purpose camera instead of a sensor. Based on this, it can correct its movement error and estimate its own movement path.

Keywords: *AGV (Automated guided vehicle), Celling Light, Guided Line, Multi-Camera, Moving Direction Estimation, OWC (Optical wireless communications).*

1. Introduction

With recent developments in technology, various technologies have been developed and industrial applications have been aimed at automating factories. The old factory had manual processes for all the factories, such as logistics, assembly. But with the recent increase in IoT and hardware precision, factory processes are automated, and transport is automatically classified and loaded [1]. Among them, the AGV is currently moving along the magnetic lines listed on the floor, and moving through the factory map and moving route. In the case of the magnetic system moving along the lines listed on the floor, it is easy to move according to the predetermined course, but an additional line is required on the floor. In the case of magnetic, there is a problem that a person may move and a leg may fall over. In addition, in the case of the method of moving through the factory map and the moving route, it is difficult to precisely locate the AGV in the room, so that the safety of the AGV is somewhat lowered, and additional accidents due to wrong

Manuscript Received: Oct. 3, 2018 / Revised: Oct. 11, 2018 / Accepted: Oct. 20, 2018
Corresponding Author: kris@seiltnn.com
Tel: +82-31-349-4396, Fax: +82-31-349-4395
SEIL Technology Co., Ltd.,

positioning may occur [2].

So in this paper, we improve the existing line tracing method and correct direction movement point detection and movement of moving AGV based on the line on the grid pattern, and move the AGV simultaneously with reception of position data from the illumination placed on the ceiling grid. In this paper, we proposed ceiling light and guided Line based Moving Direction Estimation Algorithm.

Following the introduction of chapter 1, In Chapter 2, we describe related work and research for proposed algorithm. In Chapter 3, the system configuration and algorithm of the proposed algorithm are described. Finally, Chapter 4 concludes and concludes this paper.

2. Related Work

Image processing technique is needed to recognize ceiling light and guided line using camera. Basically, it performs the desired purpose by modifying the image acquired from the camera. When transforming an image, it is basically transformed into grayscale. In order to perform a special purpose such as extracting an outline of an object, the binarization is carried out using the color value of the image. In the proposed system, Hough transform is used to recognize intersection between straight line and straight line.

The hough transform is an algorithm that transforms image pixels represented by x, y coordinate axes into a curve shape of (r, θ) coordinate axes. This have characteristic that the pixels on the same straight line in the x, y coordinate space have an intersection at the (r, θ) coordinate axes [3]. So by using characteristic, we applied proposed algorithm for moving direction estimation.

In addition, in the proposed system, AGV position information is received from the ceiling light, and the current position is continuously updated by comparing with the movement route of the AGV. In order to receive the data from the ceiling light, the ISO, shutter speed, and exposure of the camera should be modified to optimize the light recognition [4]. The ceiling light consists of LEDs to transmit data and flashes rapidly. At this time, it is possible to distinguish between the on state and the off state in the image acquired from the camera. However, it is not possible to distinguish the shape of the celling light [5][6]. Therefore, additional work is required to blur the light to recognize the original state of illumination as much as possible. In this paper, the proposed algorithm is designed based on the above research and related work.

3. Ceiling Light and Guided Line based Moving Direction Estimation Algorithm using Multi-Camera on the AGV in Smart Factory

3.1 The System Example of Proposed Algorithm

This section describes the proposed algorithm. Figure 1 shows a description of a smart factory system environment to which the proposed algorithm can be applied.

As shown in Figure 1, when the direction in which the AGV should move is determined in the direction of the arrow, when the ceiling light and the guided line are arranged, the camera installed in the front is analyzed for guided lines point. In case of the straight line correction method using ceiling light, a virtual lattice pattern is arranged in the image, and the point where the lights are arranged is straightened so as to compare the movement with respect to the direction that should actually proceed. In the case of straight line correction method using guided line, it is possible to correct the direction on the basis of the straight line data obtained based on the outline extraction, and the turning point can be extracted by analyzing the intersection point of the straight lines.

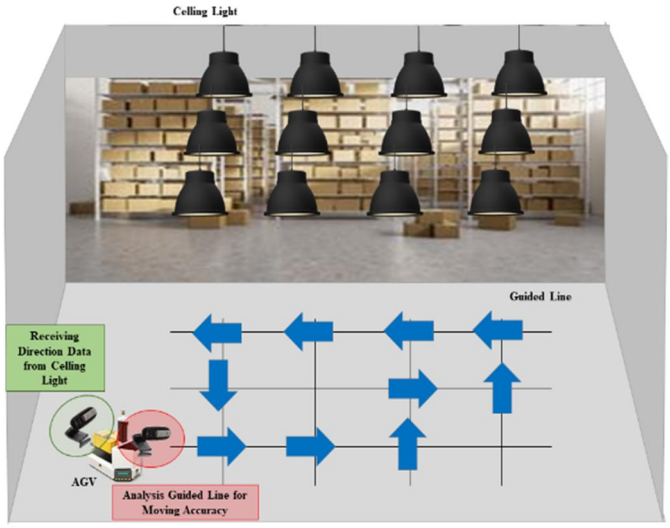

Figure 1. The System Example of Ceiling Light and Guided Line based Moving Direction Estimation Algorithm using Multi-Camera on the AGV in Smart Factory

3.2 The Flowchart of Proposed Algorithm

The flow chart for the proposed algorithm is shown in Fig 2.

First, when the system is started, the system initializes the attached device and performs environment setting in which the attached two cameras can operate. Once the configuration is complete, continue to acquire images from the two cameras.

The front camera acquires the forward image and performs hough transform. Among them, a task is performed to recognize the line. Using the image obtained through hough transform, we obtain the intersection point for the line existing in front.

The upside camera is specially modified to recognize ceiling light with ISO, shutter speed and exposure, and the acquired image is formed in a special form, not a general image, so that it is hardly recognizable. However, the ceiling light exists in the image in a bright color and recognizable form, and extracts the center of each light to recognize the line. In addition, it recognizes the data transmitted from the celling light from the closest illumination to itself and estimates its current location. Then, the acquired data are combined to estimate the current position and movement direction thereof. If the current moving direction and the moving direction of the moving object are significantly different from each other, the AGV can be controlled to be corrected.

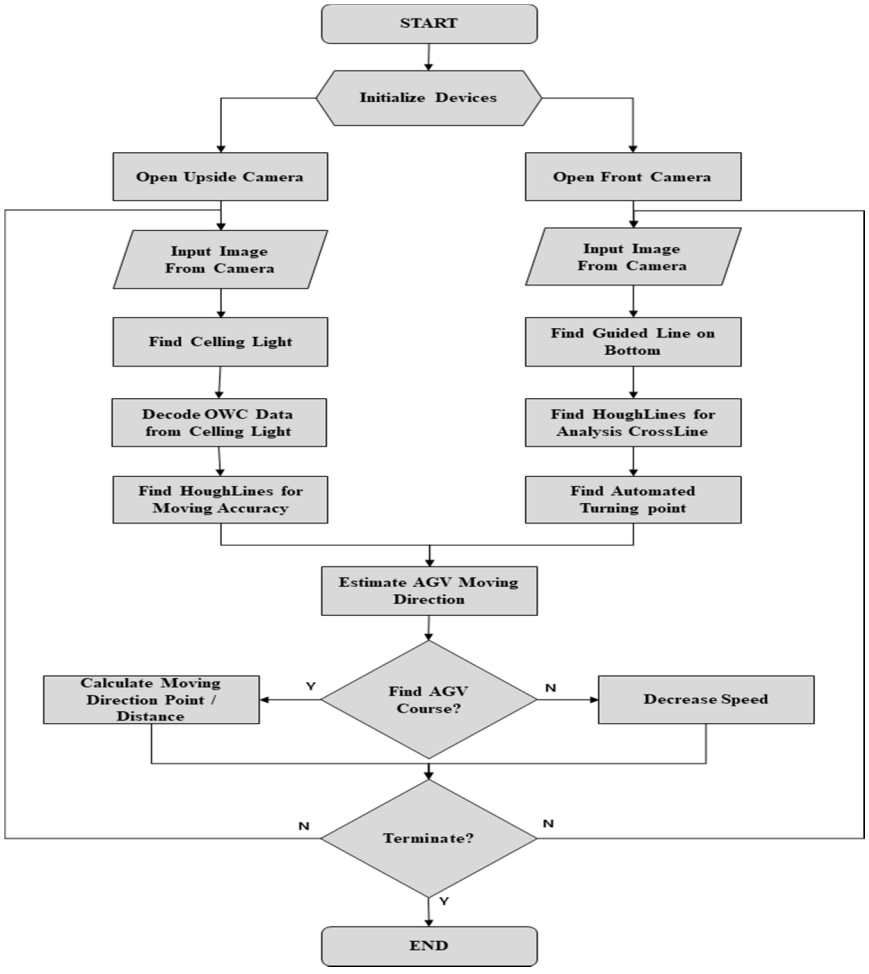

Figure 2. The Flowchart of Ceiling Light and Guided Line based Moving Direction Estimation Algorithm using Multi-Camea on the AGV in Smart Factory

4. Conclusion

In this paper, we propose ceiling light and guided line based moving direction estimation algorithm using multi-camera on the AGV in smart factory for stable AGV operation in Smart Factory. The proposed algorithm adopts image processing method based on two cameras, receives data from light, and estimates and corrects its own moving direction by using current position estimation, placement of ceiling lighting and placement of bottom line. In the proposed algorithm, it is possible to estimate the AGV motion direction based on the image processing using the camera in the AGV of the sensor unit, and it is expected that the AGV function can be enhanced by interworking with various additional technologies besides its own direction.

In addition to smart factories, it is expected to be able to derive application services combined with various industries such as autonomous driving using center lines and dividing lines existing on the roads, and can be used as valuable feed for advanced industrial technology development such as autonomous driving and artificial intelligence is expected to be.

Acknowledgement

This work was supported by the Technology development Program funded by the Ministry of SMEs and Startups (MSS, Korea) [S2449639, Development of Light Marker ID based Composite Module and Management Solution for Automated Guide Vehicle Control].

References

[1] Kyung-hoon Kim, Jae-Hong Kim, Young-ho Choi, "Logistics robot technology trends and future prospects", *KEIT PD Issue Report*, Vol. 17, No. 7, pp. 45-62, July, 2017.
DOI : http://www.korearobot.or.kr/wp/wp-content/uploads/2017/08/

[2] Sung-Shin Kim, "Technology and trend of logistics unmanned transportation system", *The Magazine of The IEEE (the Institute of Electronics Engineers of Korea)*, Vol. 39, No. 5, pp. 53-58, May, 2012.
DOI : http://insight.dbpia.co.kr/article/related.do?nodeId=NODE01874843

[3] Tarsha-Kurdi, F., Landes, T., Grussenmeyer, P., "Hough-transform and extended RANSAC algorithms for automatic detection of 3d building roof planes from Lidar data", *ISPRS Workshop on Laser Scanning 2007 and SilviLaser 2007*, pp. 407-412, 2007.
DOI : http://www.isprs.org/proceedings/XXXVI/3-W52/final_papers/Tarsha-Kurdi_2007.pdf

[4] IEEE standard for local and metropolitan area networks-part 15.7: Short-range wireless optical communication using visible light. IEEE Standard 802.15.7-2011, pp. 1-309, Sept 2011.

[5] Nam-Jin Baik, Nam-Kyu Baik, Min-Woo Lee, and Jae-Sang Cha, "A study of Location based Air Logistics Systems with Light-ID and RFID on Drone System for Air Cargo Warehouse Case", *International Journal of Internet, Broadcasting and Communication (IJIBC)*, Vol. 9, No. 4, pp. 31-37, Nov, 2017.
DOI : http://dx.doi.org/10.7236/IJIBC.2017.9.4.31

[6] Vinayagam Mariappan, Min-woo Lee, Byung-hoon Choi, Joo-seok Kim, Jisung Lee, Seong-jhin Choi, "OWC based Smart TV Remote Controller Design Using Flashlight", *International Journal of Internet, Broadcasting and Communication (IJIBC)*, Vol. 10, No. 1, pp. 71-76, Feb, 2018.
DOI : http://dx.doi.org/10.7236/IJIBC.2018.10.1.10