Developing a Machine Vision System for Certain-Object's Shape, Orientation, and Location Detection for Sorting Purposes Using a Mitsubishi Industrial Micro-Robot RV-M1 Manipulator

By
Darius Budisantosa
1-1107-006

A Bachelor's Thesis
Submitted to the Faculty of Engineering

Department of
MECHATRONICS

In Partial Fulfillment of the Requirements for

BACHELOR DEGREE

IN

MECHATRONICS

Swiss German University
EduTown BSDCity
Tangerang-15339
INDONESIA

Telp. +62 21 3045 0045
Fax. +62 21 3045 0001
E-mail: info@sgu.ac.id
www.sgu.ac.id

July 2011

Revision after the Thesis Defense on 26 July 2011

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, contains no material previously published or written by other people, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due to acknowledgement is made in the thesis.

Darius Budisantosa Date

Approved by:

Dr. Ir. Tutuko Prajogo, MSMfgE Date

Dr. Rusman Rusyadi, B.Sc., M.Sc Date

Chairman of the Examination Steering Committee Date

ABSTRACT

Developing a Machine Vision System for Certain-Object's Shape, Orientation, and Location Detection for Sorting Purposes Using a Mitsubishi Industrial Micro-Robot RV-M1 Manipulator

By

Darius Budisantosa

SWISS GERMAN UNIVERISTY

Bumi Serpong Damai

Dr. Ir. Tutuko Prajogo, MSMfgE., Thesis Advisor

Dr. Rusman Rusyadi, B.Sc., M.Sc., Thesis Co-Advisor

In this thesis, a machine vision system is built for the sorting purpose, which dedicated for pre-assembly process that able to do object recognition, location and orientation detection based on 2D shape image properties of a predefined object. In the process, sorting, orientating, and material handling tasks need to be done. To do such tasks, Diffuse Brick Lighting is applied in the system to produce silhouette image. Computer Vision library, OpenCV, will be used in the image processing process. Freeman Chain Code Feature Extraction method with Least SAD Chain Code Histogram 4-Double Shifting Bins Matching Method is used as the object recognition and orientation detection solution. Minimum Area Bounding Box method is used for location detection solution. An Image to Robot Coordinate System Transformation is applied to transform the object location in the image to the robot coordinate system. Such grabbing determination method is also applied so the robot could grab the object in a proper way. In this system, Robot Arm Mitsubishi Movemaster RV-M1 is used to perform all the works. The performance of the system is 71.4% due to disturbance from environment illumination and 3D object in 2D image perspective effect. In conclusion, by inducing vision capabilities to the robot arm, a smart sorting system is built so that predefined objects with flexible location and orientation could be sorted satisfactorily.

Keywords: machine vision, robot vision. , sorting, object recognition, location detection, orientation detection, freeman chain code.

DEDICATION

I dedicate this thesis to my advisor, my co-advisor, my lecturers, my family, and my friends for the understanding, support, advice, encouragement, and assistance they provide during the process of this thesis work.

ACKNOWLEDGMENTS

The author wishes to give my greatest gratitude to Dr. Ir. Tutuko Prajogo, MSMfgE. and Dr. Rusman Rusyadi, B.Sc., M.Sc. as advisor and co-advisor that has patiently give full assistance and support during the process of this thesis work.

The author would like to thank Dr. Anto Satriyo Nugroho, B.Eng, M.Eng for his assistance and support in teaching the programming and deeper understanding on Artificial Neural Network. The author also would like to thank his colleges, Andreas, which support the author in the programming of Artificial Neural Network.

The author also wishes to give thanks author`s lecturer especially Dr.Ir. Prianggada Indra Tanaya, M.ME. and Erikson Ferry Sinaga ,B.Sc,M.Kom and autrhor`s friends especially to Aldi Kurniawan, David Kurniawan, Dipl-ing Fiona Laoda, Noviea Kurniati, Teresa Vania Tjahja and Yosafat Surya Murijuanto for their support and assistance in this thesis work. The author also wishes to give thanks to building management of SGU and staff that allow the use of the laboratory over office hour.

The author also wishes to give thanks to author`s family and colleges for the supports and presence through the process of this thesis work.

TABLE OF CONTENTS