SHAPE DETECTION OF STRUCTURAL ELECTRONICS USING MACHINE VISION SYSTEM EMBEDED INTO SCARA ROBOT

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THESIS

Presented to the Faculty of the Graduate School of
The University of Texas at El Paso
In Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

Department of Industrial and Systems Engineering
THE UNIVERSITY OF TEXAS AT EL PASO
May 2018

Acknowledgements

I would like to express my deepest gratitude to my thesis committee chair Dr. Tseng Bill for the opportunity of being a part of his research team, and for his continuous assistance and support at each level of my master's journey. I sincerely thank my thesis committee Co-chair Dr. Amit Lopes for all his support and guidance; for sharing his dedication, knowledge, and passion for his work that highly motivated me to give my best effort in this presented research. I especially would like to thank my committee member Dr. Amit lopes for his time and providing feedback. I would like to acknowledge Sheakar Charith Boppana, for teaching me how to operate the robot. My heartfelt appreciation to the faculty and staff of Industrial, Manufacturing and Systems Engineering Department for making my stay extremely enjoyable.

Finally, I must thank my parents for their blessings, love and constant encouragement throughout my master's program. Also, I would like to thank all my friends and family members who supported and motivated me all the time.

Abstract

Additive manufacturing processes combined with enhanced technologies for electronics production enables a highly flexible manufacturing of personalized 3D electronic devices. Due to the technical progress within the last years, these technologies made their way from prototyping towards manufacturing. The growing request for products manufactured in batch size, making use of a robot to incorporate the electronic components necessary to make functional 3-Dimensional-Structural Electronics will extend the mass production possibilities. There is significant interest in automation of a process in which parameters are influential in the occurrence of assembly defects and which adjustments should be made to those variables to reduce assembly defects. The present study aimed at investigating the accuracy of the electronic parts mounted on the 3D printed board, and up to which extent these factors are significant for the accurate shape detection process. The full factorial experiment was conducted to illustrate and explain the findings in the parameter optimization. Finally, optimal settings for the robot are proposed for more repeatedly and accurately.

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Chapter 1: Introduction

1.1 Robots in Industry

The use of robots in industries has revolutionized the industrial production and manufacturing system since late 90's. Robots were used to perform simple tasks such as pick and place objects from one place to another with a point to point teaching process. By that time, they did not have any type of sensors or visual analysis equipment to analyze the further steps (neither external sensors).

They have replaced humans in monotonous, repetitive, heavy, and hazardous operations locations. Nowadays, these industrial Robots have been divided into three types based on operations, they are:

1) Material Handling Robot
2) Process Operation Robot
3) Assembly Robot

There are five fundamental laws of robotics that robots are always expected to follow, however, the following three laws are the most important:

1. "A robot may not injure a human being, or, through inaction, allow a human being to come to harm."
2. "A robot must obey the orders given by human beings except where such orders would conflict with the First Law."
3. "A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws" [1]

The first three laws of robotics have been complemented by two more laws by Stig Moberg from ABB Robotics that have been presented in the movement of robot and also taken into consideration. These two laws are:

4. A robot must follow the trajectory specified by its master, as long as it does not conflict with the first three laws.

5. A robot must follow the velocity and acceleration specified by its master, as long as nothing stands in its way and it does not conflict with the other laws. (Translated from Swedish by the author [9, p.8]).

Robots have been very successful in the Industrial Manufacturing field in the area of production, welding and material handling applications, to widening the range of quality control and machining process, for Robots are capable of handling heavy loads and sensitive operations [2]. By 1985, nearly 16,000 industrial robots were present in the United States of America. Where several benefits related to the manufacturers are observed:

1. They have reduced the labor cost.
2. Due to accurate operations, they have increased the productivity.
3. They were capable to operate in dangerous and difficult conditions.
4. They have improved the quality of the product.
5. Due to accurate operations, they have reduced the material waste during production.
6. Due to easy operations, they have increased the flexibility of manufacturing operations.
7. Industrial robots have very low capital cost.
8. Robots are easy to control and to fasten in the inventory [3].