Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

HENRY SUKARDI

BASc (Queen’s University, 2013)

“MEMS Computer Vision and Robotic Manipulation System”

Department of Mechanical Engineering

Thursday, July 30, 2015
2:00PM
Engineering Office Wing
Room 230

Supervisory Committee:
Dr. Nikolai Dechev, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Afzal Suleman, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Mihai Sima, Department of Electrical & Computer Engineering, UVic

Chair of Oral Examination:
Dr. Jens Bornemann, Department of Electrical & Computer Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

The main focus of this thesis is to explore the possibilities of micro-assembly by using computer vision as a main feedback tool for automation. In the current industry and research, most micro-assembly and micro-manipulation systems have utilized tele-operated approaches as a main methodology to achieving successful results. This is very labour intensive and not a cost effective process. Some have used computer vision to an extensive range to achieve successful manipulation for complex micro-parts. Several improvements were made on the robotic system used in this work, to manipulate micro parts. Initially, the development of a servo-based machine utilizing encoders to attain high accuracy with the ability to move in higher resolutions, was done. Ultimately, work with a stepper motor based system was used given challenges with the previous system. An optical microscopy system with high resolution, low image distortion and short depth of field, high frame rate and low processing latency image sensor, is used as a real time feedback tool for the vision acquisition and manipulation process. All of these have to be coupled by a computer, to process the motion and vision control simultaneously.

In addition, this work involved the design and development of microchip components to be manipulated, in order to make automated assembly a possible reality. A great deal of research and development was done to scrutinize previous chip designs and possible ways to improve the existing design. The chip components have incorporated changes in geometry and tolerances to improve the probability of success of gripping and joining. The chip also has a unique form of surface markers as reference geometry for the computer vision to calibrate its position in space and have a set origin. The chip has also been designed in a way that streamlines the efficiency of the micro-assembly process and reduces the minimum number of movements required of the servos and stepper motors in order to achieve successful assembly.