

# DESIGN AND IMPLEMENTATION OF THREE-AXIS ROBOT

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## ABSTRACT

THE OBJECTIVE OF THE RESEARCH IS TO DESIGN AND TO IMPLEMENT A ROBOT ARM WHICH CAN BE USED IN THE SEMI-CONDUCTOR PROCESS. GENERALLY, THE REQUIREMENTS OF THE WORKING ENVIRONMENT OF THE SEMI-CONDUCTOR PROCESS ARE VERY STRICT, SUCH AS IN CLEAN ROOM OR IN A VACUUM CHAMBER. THE ACTUATOR USED IN THE ROBOT ARM USUALLY CAUSE POLLUTION IN SEMI-CONDUCTOR MANUFACTURE. THEREFORE, IT IS NECESSARY TO ISOLATE THE ACTUATORS FROM THE CLEAN ROOM OR THE VACUUM CHAMBER. THEN, GEARS AND BELTS ARE USED TO DRIVE THE ROBOT ARM TO ACHIEVE THE DESIRED MOTION. IN THIS WORK, THE SOLIDWORKS2000 IS USED AS A TOOL TO DESIGN AND TO DRAW THE ROBOT ARM, AND THE WORKINGMODEL IS USED FOR THE MOTION SIMULATION AND THE PATH ANALYSIS. MOREOVER, THE DESIGNED ROBOT ARM IS MANUFACTURED AND SETUP IN OUR LABORATORY. THE TRANSMISSION OF POWER OF THE ROBOT ARM IS DONE BY USING BELTS AND GEARS. THE SERVO MOTORS ARE USED TO CONTROL THE MOTION OF THE ROBOT ARM THROUGH THE BELTS. ALSO, A COMPUTER PROGRAM USING VISUAL BASIC, INCLUDING THE SERVO MOTOR CONTROL AND PATH PLANNING OF ROBOT ARM, IS DEVELOPED. THUS, THE ROBOT CAN PERFORM ITS MOTION AS DESCRIBED. A COMPUTER IS USED TO CONTROL THE SERVO MOTORS AS WELL AS THE ROBOT ARM THROUGH A COMPUTER INTERFACE. MOREOVER, THE SIMULATION AND THE CONTROL OF THE ROBOT ARM MOTION CAN BE DONE SIMULTANEOUSLY. FINALLY, THE ROBOT ARM MOVES AS DESIRED AND THE OBJECTIVE OF THIS WORK IS ACHIEVED. THE RESULTS OF THIS WORK LAY THE GROUND WORK FOR THE FUTURE RESEARCH, INCLUDING THE INTEGRATION OF THE ROBOT ARM AND TRI-AXIAL SHAFT SEAL USING MAGNETIC FLUID, THE OPTIMIZATION OF THE PATH CONTROL OF THE ROBOT ARM, THE FEEDBACK CONTROL OF THE ROBOT ARM, AND ETC.

Keywords : robot-arm ; vacuum

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## REFERENCES

[ 1] JOHNJ. CRAIG, "INTRODUCTION TO ROBOTICS MECHANICS ANDCONTROL ,"ADDISON-WESLEY PUBLISHING COMPANY, 1989, DENVER, USA [ 2] 江耀宗,林崇賢編譯,"機械人原理與系統,"全華科技圖書股份有限公司, 1991 [ 3] 卓聖鵬編譯,"機械人控制,"全華科技圖書股份有限公司,2000 [ 4] 郭俊良,王培士編譯,"機械人的機構與控制,"全華科技圖書股份有限公司, 1988 [ 5] 黃緒哲譯,"基本機械人學,"徐氏基金會, 1988 [ 6] M. VUKOBRATOVIC.著, 趙平譯,"機械人的手-力學與運動,"臺隆書店, 1983 [ 7] 武晉偉,"平面與球面三自由度並聯式機械人之正運動學分析,"國立台灣科技大學機械工程研究所碩士論文, 1999 [ 8] 黃美翠,"帶驅動式機械手靈巧操作之控制,"國立成功大學機械工程學系碩士論文, 1989 [ 9] 何明果,"並聯式機械人之設計、開發與應用,"私立大同大學機械工程研究所, 1999 [10] 黃欲仁,"晶圓輸送機械手臂之機構分析及運動控制研究,"私立中原大學機械工程研究所碩士論文, 1999 [11] 鄭榮宗,"三軸直接驅動機械手臂之研製,"國立台灣科技大學機械工程研究所碩士論文, 1998 [12] 盧添福,"四軸機械臂之研製,"國立成功大學機械工程學系碩士論文, 1990 [13] 何明哲,黃衍生編著,"WINDOW下之馬達控制入門,"全華科技圖書股份有限公司, 1999