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Development of a CAD Based Platform for Scorbot-ER Vu Industrial Robot Manipulator

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Abstract

Robots are required to operate at different environmental conditions facing varieties of end-effector to workspace interactions. During design stage, designer needs to verify the robots performance on various test conditions. Physical prototyping although is more desirable, may prove to be expensive and time consuming. Virtual prototyping can be used especially in the conceptual design stage in order to reduce the amount of physical testing that is required. Virtual prototyping of robots dynamic is one of the interesting fields where in the present day tools are used to simulate mechanical systems as a multi-body system with two or more rigid bodies imperfectly joined together having the possibility of relative moment between them. This paper discusses the application of Virtual Prototyping using CAD based software for SCORBOT-ER Vu robot. It is a 5-DOF of vertical articulated robot and all the joints are revolute. Initially, robot manipulator parametric solid models was created in Pro/ENGINEER (Pro/E), Pro/Mechanica was used to simulate the dynamic simulation and working space. Finally the program was tested in the real world, using the real robot.

I. INTRODUCTION

Industrial robot can be defined as a re-programmable, multifunctional mechanical manipulator designed to move material, parts, tools or specialized devices through various programmed motions for the performance of a variety of tasks. Virtual Prototyping is an aspect of information technology that permits analyst to examine, manipulates, and tests the form, fit, motion and human factors of conceptual design on computer monitor. Furthermore, a virtual prototype can be generated quickly and modified easily in the early stages of the design process, which means the designer can consider other alternative designs throughout the design process [1]. A computer-based simulation of a system or subsystem with a degree of functional realism comparable to a physical prototype" and virtual prototyping. The process of using virtual prototype, in lieu of a physical prototype for test and evaluation of specific characteristics of a design. Virtual prototyping can replace the expensive physical mock ups constructed to test design [2]. Based on

features modeling, Pro/E is a parametric modeling tool, which is produced by PTC. The parametric modeling method means that the designer could set the parameter to drive the geometry size of the part and could remodel the part easily by changing the parameter [3 and 4]. Simulation is the process of designing a model of an actual or theoretical physical system, executing the model, and analyzing the execution output. The robotic simulation package is a tool which is used to create embedded applications for a specific robot without depending "physically" on the actual robot, thus saving cost and time. Most robotic simulation packages have their own unique features, but the main features for 3D modeling are robot rendering and environment [5and 6]. This paper reports an approach to creating a complete virtual prototype of Industrial Scorbot-ER Vu Robot and its virtual motion analysis by Pro/Mechanica tool.

II. SCORBOT- ER Vu INDUSTRIAL ROBOT

The SCORBOT - ER Vu is a 5-DOF of vertical articulated robot and all the joints are revolute. This design permits the end-effector to be positioned and oriented arbitrarily within a large work space. Each joint is restricted by the mechanical rotation its limits are shown below.

Joint Limits:

Axis 1: Base Rotation: 310º
Axis 2: Shoulder Rotation: +130º / -35º
Axis 3: Elbow Rotation: ±130º
Axis 4: Wrist Pitch: $\pm130°$
Axis 5: Wrist Roll: Unlimited (Mechanically); $\pm570°$ (Electrically)

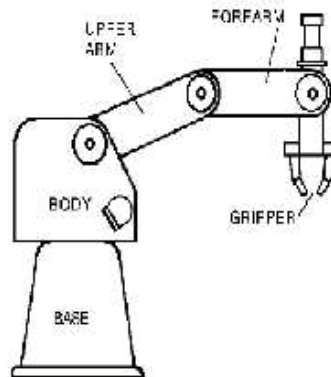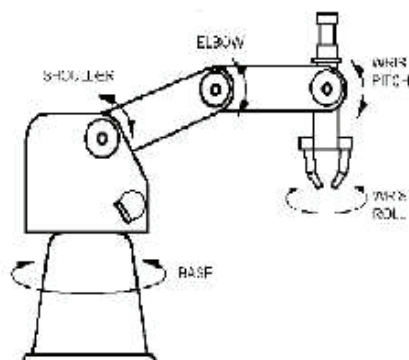The mechanical arm links and joints of the Scorbot ER-Vu are illustrated in Figure.1 and Figure.2.

Figure 1: Scorbot ER-Vu Robot Arm Links