

CAD Based Robot Programming

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Abstract

The purpose of this paper is to discuss how robots deal with unpredictable environment based on CAD systems. Most of manufacturing companies use CAD packages. Robot programs are generating by using CAD drawing and these programs are commonly running on 3d CAD packages. By using 3d CAD package there is no expert skill is required to operate the robot programming. The 3d CAD packages are low cost and less time setup system. In this paper an experiment is discussed of robot programming that are generated from CAD drawing. In the end of this paper the overview of CAD related work is discussed.

Key words: CAD, robot programming, unpredictable environment, sensory feedback

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INTRODUCTION

The current study is about the robot programming based on CAD systems. As the technology is improving day by day, the companies/industries are changing their product systems. The old manual manufacturing works are replaced by intelligent and flexible manufacturing systems to become more competitive in global market (Kopacek, 1999). This competitiveness of companies is to producing better quality of products at competitive packages.

A robot plays a major part in industry due their flexibility. But still small problems are occurred in utilization of robot in small and medium enterprises (SMEs). SMEs got difficulty in finding the skilled workers to work with robots. The goal is how worker teach the robot in the similar manner they teaches the humans to work each other for example by using CAD drawings (Neto et al., 2010a).

Robot programming through typical method are time consuming and requires technical expertise. The goal is to develop the method that help the user to program a robot quickly. CAD systems allow the users to generate a robot program by using 3d drawings. The well known CAD generic packages are 3d drawing and Autodesk inventor.

Unpredictable and sensory feedback

The manipulation of robot is successful if the robot has some information about the object of their surroundings. In unpredictable environment no information is provided. In

this case robot requires some information about their surroundings to support their decision making. The sensory feedbacks are used to provide the information about the surroundings is shown in fig 1 (Bolmsjo and Olsson, 2005; Johansson et al., 2004).

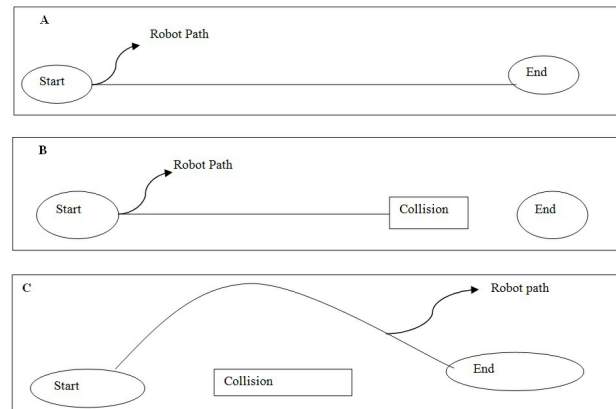


Figure 1. A) Path defined for robot, B) Collision occur between path, C) Sensory feedback is used that help robot to deal with unpredictable environment.

In robotics the integration of sensor reduces the setup of time and provide accurate robot trajectory programming (Bolmsjo and Olsson, 2005; Johansson et al., 2004).

Robot programming using cad

In CAD environment the user generates a robot program by 'Drawing' the robot path. After that information from CAD environment are extracted and converted into robot programming. It is notice that robots program

are not extracted by using CAR (*computer aided robotics*) software's.

CAR packages are powerful tool but they have some disadvantages when using in companies like SMEs. By comparing CAR packages with CAD packages, it is notice that CAD has following relative advantages (Neto et al., 2010b).

- A. Low cost
- B. Simplicity of use

A) Low cost

The robot programming and construction of CAD models are performed in same environment.

B) Simplicity of use

The most time consuming task.

If the environment of robot task are well defined makes the robot programming work well. But in CAD model it is not possible to reproduce the geometry of real scenario correctly.

Furthermore it is necessary to know robot pose (position and orientation). After the path of the robot are drawn they must be placed along the path of simplified tool models. They define the orientation of the robot along the segments of path as shown in figure 2.

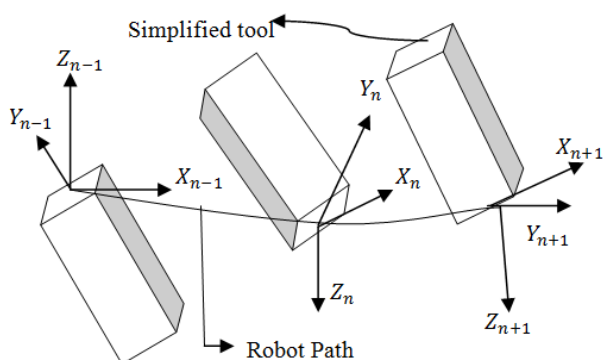


Figure 2: Simplified tool models defining the orientation

The Autodesk provided application programmable interface (API) to extract the information from CAD environment to program the robot. This API allows defining the robot path, straight lines and arc. The information about the transformation matrix in CAD environment is provided by API.

The transformation matrix contains the position and orientation of part model refers to the origin of assembly model. After that information are extracted from CAD environment and converted to robot programming (Video, 2010). The conversion of 3d data from CAD into robot program is shown in figure 3.

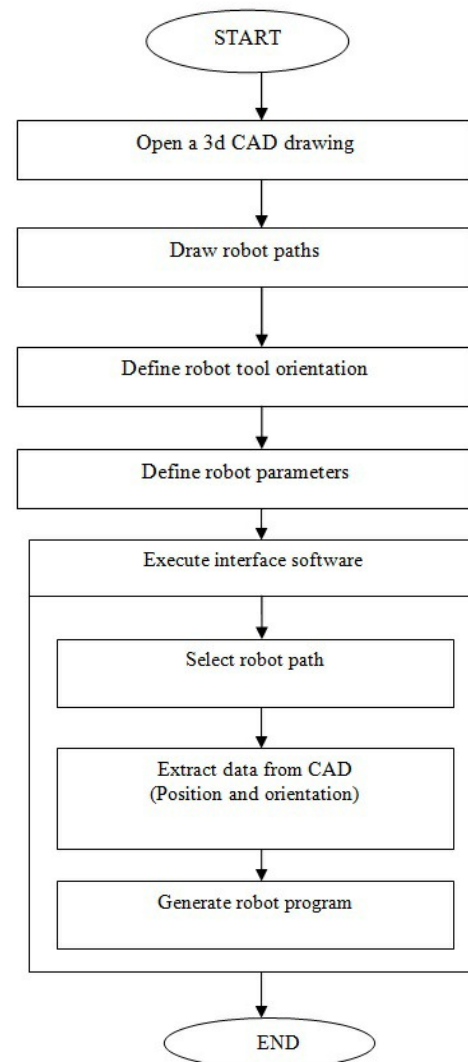


Figure 3. Extracting 3d data from CAD [6]

Application programming interface

The API of Autodesk inventor functionalities are in object oriented manner that allow the developer to interact the Autodesk with the programming language like c-sharp, C++, and VB. API are used to extract the information from CAD and AAS *Autodesk Apprentice server* are used to display the CAD models as shown in figure 4.

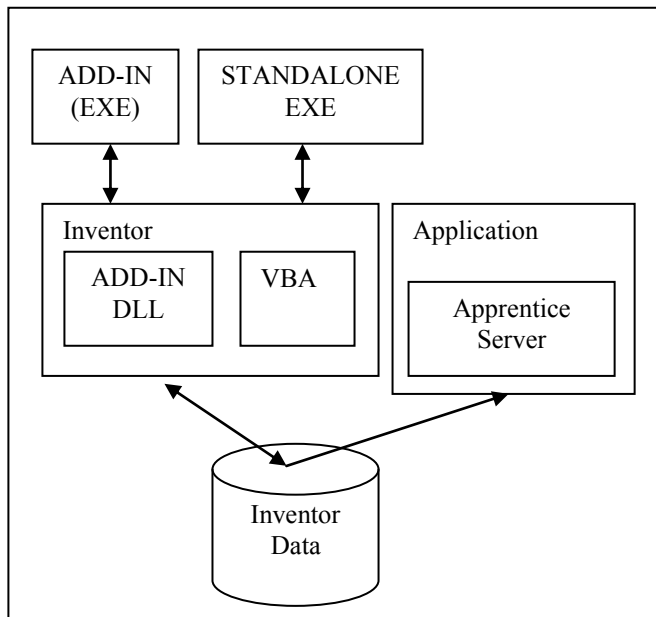


Figure 4: way of accessing Autodesk inventor API [8]

A method show in the flow chart is describing how to automatically extract the information of straight line from CAD as shown in figure 5.

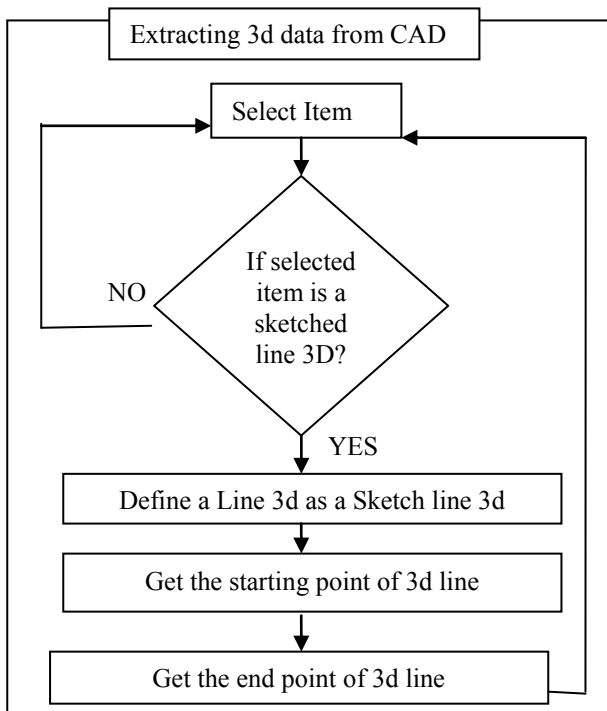


Figure 5: Flow chart of extracting data of straight line

Experiment

In this experiment, the robot programs are generating from CAD drawing. The experiment of seam tracking in which robot path are adjusted from the information is received from laser camera attached to the robot.

A. Seam Tracking Experiment Setup

The figure 6 shows the experimental setup of robotic platform having industrial robot, a computer with operating system of Microsoft windows 8 and a laser camera.

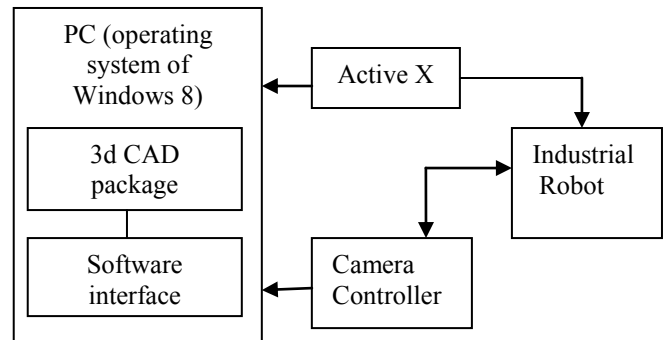


Figure 6: Robot operating system architecture [9]

The computer is running a CAD package with software interface which receive the data from CAD to generate robot program. The software interface is remotely controlled and managed the robot by using activeX but sometime PcRob are also used for such purpose. The laser camera is connected with robot via serial port.

Overview of cad related work

From last few years CAD based system are more attractive and easy to work. The millions of worldwide SMEs companies use CAD system to design and model their products. In eighty's CAD technology was used to develop the robotics (Bhanu, 1987). The CAD based system are used to extract the information of robot motion from CAD DXF file and convert it to the robot command used for the purpose of welding (Pires et al., 2004). Chen *et al.* (2009) represent the CAD based robot for spray painting [12]. Nagata *et al.* (2007) represent the sanding platform of robotic where CAD/CAM generates the robot path [13]. The CAD system generates a robot path for polishing processes [14]. The unpredictable environments are the challenging task because of their complexity. A lot of studied is carried out for dealing with uncertainty in the fields of robotics [15] [16]. The sensor was used in robotics to avoid problems such as collision (Johansson et al., 2004) [17]. The most important work is the integration of sensor to assists the arc welding of robotics (Bolmsjo and Olsson, 2005) [18].

CONCLUSION

As we know technology of robot generation are rapidly improving day by day. The robot developers are implementing new concept to makes the robot more flexible. The purpose of our work is to describe that CAD based robot programming is easy to use. Our work is to be presented the CAD based robot programming with unpredictable environment. We can see that construction of CAD model and robot programming are performed on same platform which becomes easier and cheaper. By adding sensory feedback to robot makes the robot more flexible in the unpredictable environment. The CAD based systems are very useful in SMEs that produce small products which constantly reprogram the robotic cells.

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