Microdelta 2.0

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Robotics
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The research center CSEM SA developed a delta robot 15 years ago, which worked very well for demonstration and research purposes. Meanwhile, the motor control computer and the motor controllers are outdated. For this reason, a new model of motor controller with EtherCAT interface has been purchased. This thesis deals with the commissioning of a MiniMACS6 motion controller from zub machine control AG.

Introduction

CSEM developed the Microdelta robot 15 years ago. This is a small parallel robot with excellent pick-and-place capabilities. CSEM would like to upgrade all mechanical and electrical components of the Microdelta.

Objective

As a first step, the mechanical and electrical components of the robot are to be checked and replaced if necessary. Subsequently, the three old Elmo Whistle controllers shall be replaced by the new MiniMACS6. CSEM SA is interested in exchanging data with the controller in real-time. The real-time capability is provided by EC-Win, a Windows EtherCAT real-time platform from Acontis. In addition, a path planner is to be implemented, which sends Via Points to the robot. A demonstration shall be developed where the robot detects parts on a turntable with a camera and grips them. The demonstration is also expected to be controllable via CSEM SA vertical process integration platform called VISARD written in C#.

Methods

Based on the hardware analysis, the reed limit switches were replaced. The new controller was wired and tested. The parameters for the motors, encoders and the control were set on the controller. A model already existed for the kinematics of the robot, which was then parameterized. To ready the robot for the demonstration, a homing process and an emergency stop handling were added. Subsequently, EC-Win was installed and EtherCAT communication was established between the EC-Master and the controller in real-time. A fifth-order polynomial path planner was developed along with a pick-and-place demonstration.

Results & Outlook

The controller is integrated with the delta robot, and it is possible to send and receive process data over EtherCAT in real-time with a cycle time of 1ms. A pick-and-place demonstration with fixed positions was implemented. The turntable can be controlled and the parts on it can be detected with a camera. A working version of the path planner has been developed but not yet implemented on the EtherCAT master. The gRPC communication works. The current position of the robot is published and requests can be sent to move the robot to a desired goal pose. The movements are currently executed in joint space. As soon as the path planner is integrated, they will be executed in Cartesian space.

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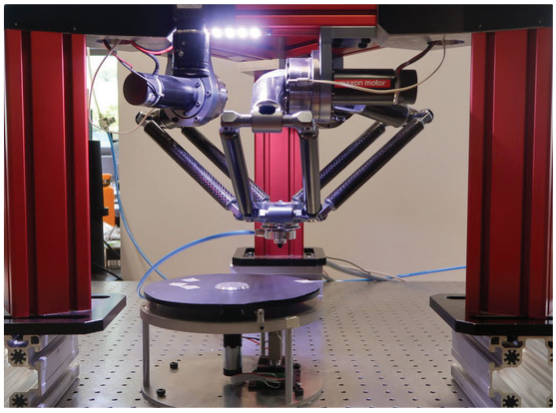

Figure 1: Delta Robot

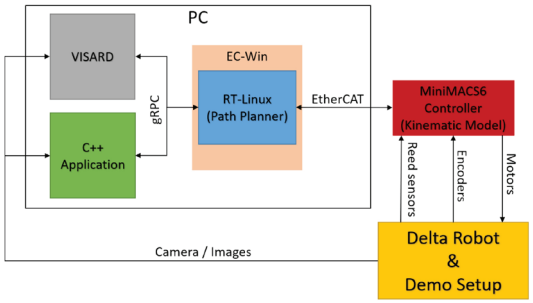

Figure 2: Software Block Diagram