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Controlling a Delta Robot Using Mapp Robotics and OPC-UA

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ABSTRACT

In this paper, a machine centric robot is designed for desired application by using Mapp Robotics and OPC-UA. Also the HMI display screen is designed for a robot. A delta robot is designed for the favored application. It has2 motor drives linked to four motors, via way of means of controlling the drives and motors, asynchronized movement of the manipulator is completed which leads to a robot application. Operator can manipulate the robot automatically and manually via way of means of giving instructions through HMI as well. This robot will perform tasks on the basic of g-code, m-code and n-code(type of CNC programming) written on the program.

Keywords:— *3 axis delta robot , automation studio, scene viewer, VNC, OPC-UA, mapp technology.*

I. INTRODUCTION

The aim of the paper is to offer unprecedented levels of machine flexibility and precision by merging robotics with machine control enabling remote access, increased efficiency and also save floor space.

Robots are an integral part of automation industry. Traditionally, robots used in machines are self-contained, with their independent controller and its control cabinet. The configuration, diagnostics and maintenance of robot are all performed using a dedicated system, with a specific robotic language. The se robots have to be coordinated with them achiness so that they can give the required output. This system requires dedicated controller for each machine and robot. Therefore, machine centric robot is required which has only one controller. As this robot will no longer

require a dedicated controller, all interfaces between the machine and the robot are eliminated, while the fact that all axes and sensors will now communicate on a common net work increases precision and speed of response. This also helps to increase the productivity of the machine and the output of the process.

II. METHODOLOGY

In this paper, a machine centric robot will be controlled for a certain process using Mapp Robotics and HMI screen will be developed for the robot. The objectives of the paper are under standing a robot mechanically along with its features, specifications, electrical wiring and sensors used in the robot.

Furthermore, understanding synchronization between sensors and robot motion, studying the communication networks and applications. The main phase of the paper will include user friendly programming of robot according to the specified application using Mapp Technology.

Testing and debugging the robotic model on a software, where the entire robot can be simulated and the program can be transferred and working of the robot can be examined and lastly developing and programming the HMI screen for the robot.

2.1 Circuit Diagram

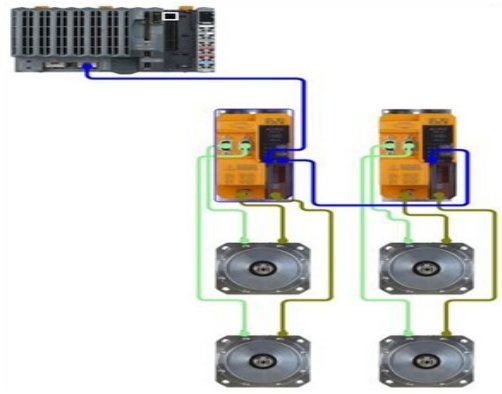


Figure 1: Circuit Diagram [7]

Figure highlights the system circuit diagram, which consist of CPU, Motor drivers and motors. The X20CP1586 is a powerful X20 system CPU. The CPU has a slot available for X20 communication modules. Various bus and network systems can easily be integrated into the X20 system through the use of communication modules. Motor drivers acts as an interface between the motors and the control circuits.

Green lines indicates encoder cables which are connected between motor drivers and motors. Blue lines indicates, POWERLINK cables while Brown cables shows the connection to the motor.

2.2 Hardware

(a) CPU(X20CP1586)

Figure 2: CPU [7]

- Intel Atom 1.6 GHz processor with an additional I/O processor
- 1 slot for modular interface expansion
- Onboard Ethernet, POWERLINK with poll response chaining and USB
- Compact Flash as removable application memory
- 512MB DDR2 SDRAM
- Fan less

(b) Motor Driver (80VD100PD):

Figure 3: Motor Driver [7]

- Control for 2 motors
- 2 EnDat 2.2 interfaces
- Motor connector: 24 to 64 VDC±25%, nominal $8A_{RMS}$ (maximum$10.6A_{RMS}$)
- Switching frequency : 5, 10 or 20 kHz
- Complete integration in Automation Studio and CNC applications
- Operation using PLC open function blocks
- 2 trigger inputs
- Motor holding brake connection
- Enableinput

(c) Motor (8LVA)

Figure 4: Motor [7]

The most advanced machine concepts demand excellent dynamics and performance within the smallest amount of space possible. 8LVA three-phase synchronous motors from B&R were specially developed for the se applications and provide users with the highest level of freedom in machine design by delivering maximum power density.

2.3 Software

(a) Automation Studio

Figure 5: Automation Studio [7]

A single uniform programming tool for every aspect of an automation paper minimizes training needs, solidifies overall integration, and eliminates communication problems between engineering disciplines.

(b) Scene Viewer

Figure 6: Scene Viewer [7]

The B&R Scene Viewer is an OpenGL-compatible 3D visualization tool. It is designed to support the development of CNC, robotics and ACOPO Strak applications. The software provides ready-made models but also allows you to create your own objects.

(c) VNC (Virtual Network Computing)

Figure 7: VNC [7]

The B&R VNC Viewer is a version of the well-known remote administration software that has been adapted for B&R devices. This program can be used to remotely control another computer where VNC Server is running.

2.4 Programming Languages

1. G Code and M code

The G code is written in an alpha numeric format and is responsible for the movements of the se machines. It tells the machine where to start, how to move, and when to stop when fabricating apart.

- G02 (Clockwise interpolation)
- G03(Counter-clock wise interpolation)

2. Structured Text (ST)

Structured text, abbreviated as ST or STX, isoneofthefivelanguagessupportedbytheIEC 61131-3 standard, designed for programmable logic controllers (PLCs).

3. Ladder Diagram

Ladder diagrams are advanced schematics widely used to record logic structures for industrial controls. These are called ladder diagrams because they mimic a ladder, with two vertical rails (supply power) and as many "rungs" (horizontal lines) as there are to represent control circuits.

III. PROGRAMMING

(a) Helix programming with angle of rotation

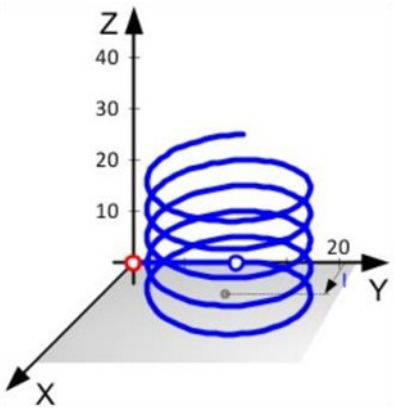


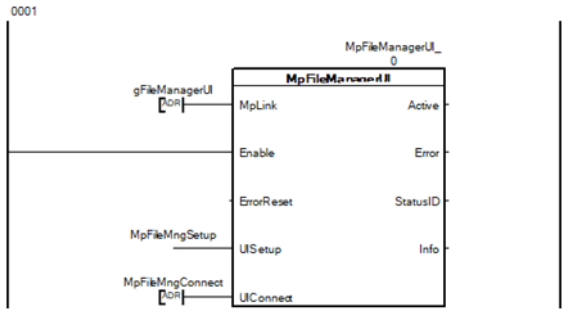
Figure 8: Helix [7]

```
%001
N10 G01 X0 Y100 Z-700 F5000 (move to start position of helix)
N20 G02 I20 H1800 Z-540 (5 full rotations)
N99 M30
```

(b) PLC Main Program in Structure text

```
PROGRAM _INIT
    (* Insert code here *)
    MpDelta3Axis_0.MpLink := ADR(g3AxDeltaA);
    MpDelta3Axis_0.Enable := TRUE;
    MpDelta3Axis_0.Parameters := ADR(DeltaParameters);

    MpDelta3Axis_0.Override := 100.0;
    DeltaParameters.ProgramName := 'CncProg';    //File stored on FileDevice


END_PROGRAM

PROGRAM _CYCLIC
    (* Insert code here *)
    MpDelta3Axis_0();
    Simpos[0]   := LREAL_TO_REAL (MpDelta3Axis_0.X);
    Simpos[1]   := LREAL_TO_REAL (MpDelta3Axis_0.Y);
    Simpos[2]   := LREAL_TO_REAL (MpDelta3Axis_0.Z);
END_PROGRAM

PROGRAM _EXIT
    (* Insert code here *)
    MpDelta3Axis_0.Power  := FALSE;
    MpDelta3Axis_0.Home   := FALSE;
    MpDelta3Axis_0.MoveDirect := FALSE;
    MpDelta3Axis_0.MoveLinear := FALSE;
    MpDelta3Axis_0();

    MpDelta3Axis_0.Enable := FALSE;
    MpDelta3Axis_0();

END_PROGRAM
```

(c) HMI programming in Ladder diagram:



IV. MAPP SERVICES

(a) Alarm Management

Figure 9: Alarm [7]

Mapp AlarmX collects and manages both mapp alarms and user alarms. The alarms are configured using Automation Studio, managed in the application and then displayed in an HMI application or exported as a file.'

(b) Recipe Management

Figure 10: Recipe [7]

Mapp Recipe provide sall of the functions necessary for simple yet high-speed recipe management.

(c) Data Logging

Figure 11: Data [7]

Mapp Data makes it possible for users to back up values of defined process variables (PVs). This data is stored in CSV files.

(d) User login

Figure 12 User Login [7]

Mapp User X sets up user management. Roles and users are created using the user role system in Automation Studio (OPCUA compliance included) and the n managed using Mp User X.

(e) File Management

Figure 13: File [7]

Mapp File provides a file management system as well as a connection to the HMI application to display files.

(f) Audit

Figure 14: Audit [7]

This section will demonstrate how to record a user event using Mp Audit.

V. RESULT

A clockwise helix is programmed. The circle is defined by specifying the center point and the angle of rotation. A height value (distance) is also programmed. The feed rate on the path in space is adhered to.

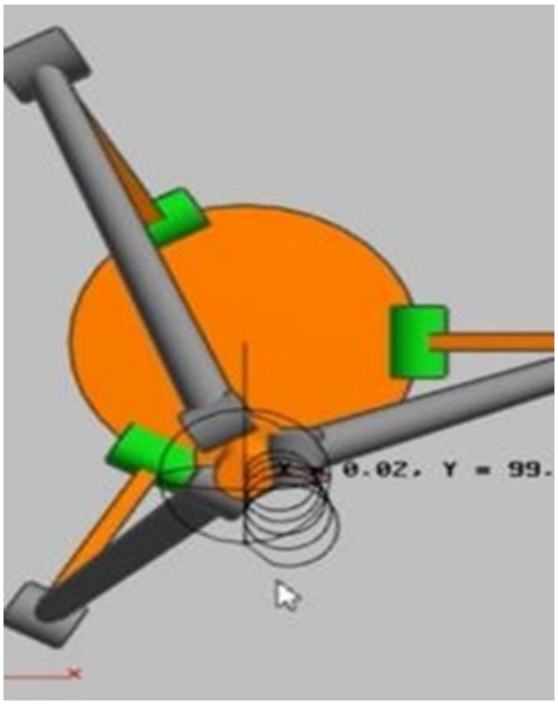


Figure 15: Result (a) [7]

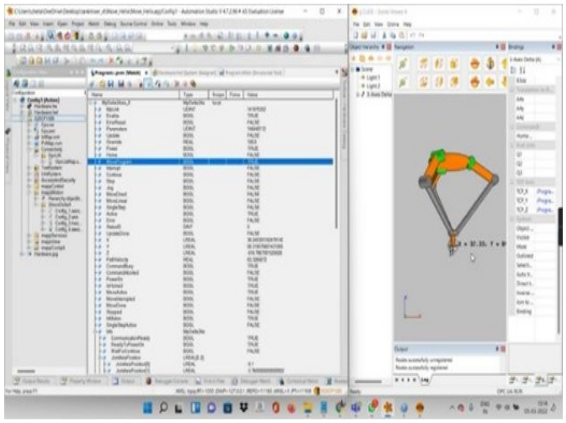


Figure 16 (b): Result [7]

VI. CONCLUSION

In this paper, we learned many areas of engineering to build a robot. We designed a 3 Axis delta robot to perform tasks.

Furthermore, we used many aspects of computer engineering interchangeably to program the robot so that it can perform the task successfully. The programming part was little tricky and needed many trials.

So, we are concluding that this Delta robot is having great flexibility and can be programmed to perform desired tasks.

REFERENCES:

[1] B & R Automation YouTube Channel https://youtube.com/c/brautomation/

[2] Help Section of Automation studio. Automation Studio Help Centre Website-http://help.nice-automation.com

[3] Hongxia Wu. “Research on Control System of Delta Robot Based on Visual Tracking Technology” (2021)

[4] Ting-Yu Ye, Lihong Zhao. “Design of Industrial Robot Teaching System Based on Machine Vision” (2021)

[5] Manuka Suriyage “3-DOF parallel delta Robot with GA based vision and

path planning technique" (2018)

[6] Analysis and dimensional synthesis of the DELTA robot for a prescribed workspace (2007)

[7] https://www.br-automation.com/en-in

[8] A clockwise helix is programmed. The circle is defined by specifying the center point and the angle of rotation. A height value (distance) is also programmed. The feed rate on the path in space is adhered to.

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