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Controlling 4 Axis Delta Robot Using Mapp Technology & Developing HMI

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Abstract: *The project is an overview of robotics, its brief history, in which we come to know that how it was initialized and who are the pioneers of robotics. Further, on which basis they are classified and at the end of this chapter there are some implemented and future applications of robotics all around the world. Literature review is in and it is about the mechanics and motions of robotics further, there are brief theories on positioning, orientation, degree of freedom and geometry involved in robotics. At the end of this chapter servo motors are discussed in greater depth. Research methodologies are placed. design and material selection are the main concern of mechanical design of robotic arm and what sort of hardware selection is carried out which suites best the servo drive. also learn mechanical and electronic hardware selections are implemented along with the best suitable power supply unit and microcontroller. At the last but not the least is the summarized version of our achievements, limitations facing in project, robotics in future, cost analysis and conclusion. We mention point to point references for every student who want to ripe this fruit and enhance the curiosity. This represents an ideal pick and place robot should carry out the operations in minimum time and should also be cost efficient. One of the fastest configurations of industrial robot used is the Delta configuration. It is three degrees of freedom parallel configuration used for very high-speed pick and place operations capable of achieving high cycle rates up to 200 cycles per minute.*

I. INTRODUCTION

Moving 4 axis the predefine robot in turn is an important function in existing industrial robots that offer the same an area with a predefined movement pattern .so our project helps to provide performance time input from the user to change the axis pattern using the touch screen. That includes three arms connected to universal joints at the base. A key feature of the design is the use of parallelograms on the arms, the latter orientation of the end effector, unlike the Stewart platform that can change the shape of its final result.

II. BRIEF LITERATURE SURVEY

Moving 4 axis Robot with predefine sequentially is critical task existing industrial robot are giving same facility with predefine motion pattern. So, our project helps to provide performance time input from user to change axis pattern using the touch screen. That includes three arms attached to universal joints at the base A key feature of the design is the use of parallelograms on the arms, the latter orientation of the end effector, unlike the Stewart platform that can change the shape of its final result. Delta robots have popular uses in selection and selection packing in factories because they can be very fast, some make 300 picks per minute. It contains many kinematic chains that connect the base with conclusion.

The robot can also be seen as normal for connecting four bars with the help of B&R Scene Viewer, robotic machine models can be easily created and the movement of the robot can be displayed and recorded without any real hardware. This allows the robotics application to be tested in advance and reduces the amount of time required for commissioning on the machine. The configuration of a compatible or delta robot is one of the latest developments in configuration. This includes machines whose arms have parallel prismatic or rotating members. These were improved like overhead machines with motors contained in the base structure driving linked arms below. The benefit of this approach is that it reduces the weight within the arms and therefore provides very high acceleration and speed capability. They have a low load capacity Therefore, the main application picking, especially in the packaging lines of the food industry, as well as integration applications.

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These machines can achieve the same cycle times in SCRA with rapid gain of pole test (25, 300, 25 mm) at 0.3 s. This type of robot is for sale relatively small, gaining only about 1% of the world's total market.

III. OBJECTIVES

The objective of the proposed system is given below

1. The select and design parallel manipulator robot for a required workspace.
2. To configure and monitor 4 axis delta robot features on automation studio.
3. To connect scene viewer with automation studio to visualize 4 axis delta robots.
4. Write a G - code to define particular movement example to draw an image of hexagon**.**
5. To develop an application based on Human Machine Interface (HMI).
6. To obtain good repeatability and accuracy with high-speed movement of the robot.
7. To use MAPP Technology to integrate additive on the MAPP Motion features.
8. To implement OPA UA communication protocol.

IV. PROBLRM STATEMENT

To define and execute an algorithm to control 4 axis delta robots with consumption from user in runtime. this project, the robot in the middle of the machine will be controlled by a certain process using Mapp Robotics and HMI screen will upgrade the robot. A 4-axis robot is controlled for the desired application. It has 2 drives connected to 4 motors, by controlling the drives and motors, a synchronized motion of the manipulator is performed which results in a robotic application, for example the manipulator of the robotic arm will trace 'B&R'. Operator can control the robot automatically and manually by giving commands 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. These processes are then analysed and one or multiple processes are chosen to be automated through RPA. This takes up a lot of time and is prone to errors.

Therefore, the following two problems are identified:

1. It is difficult to find and pick the right candidate process for a Robotics Process Automation project.
2. Finding potential candidate processes is time consuming and often a manual process which could be improved upon.

V. BLOCK DIAGRAM

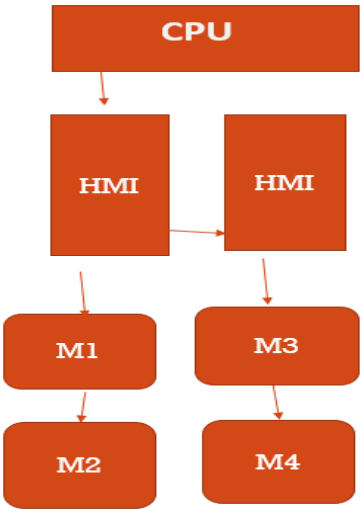

Figure: Block Diagram of delta robot

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VI. HARDWARE SPECIFICATION

Table 1: Specifications of Controller X20CP1586

Name of Property		Details	
Application	:	This CPU is especially useful for applications which require short cycle times	
Operating Conditions	:	**Temperature :**	
		Horizontal mounting orientation	-25 to 60°C
		Vertical mounting orientation	-25 to 50°C
		Storage	-40 to 85°C
		Transport	-40 to 85°C
Standard memory	:	RAM	512 MB DDR2 SDRAM
		User RAM	1 MB SRAM
Processor	:	Type	Atom E680T
		Clock frequency	1.6 GHz
		Data code	24 kB
		Program code	32 kB
		L2 cache	512 kB
Input I/O Power Supply	:	**Input voltage**	24 VDC -15% / +20%
		Fuse	Required line fuse: Max. 10 A, slow-bl
Output I/O Power Supply	:	**Nominal output voltage**	24 VDC
		Permissible contact load	10 A

Table 2: Specification PLC 80VD100PD.C000-01

Name of Property		Details	
Application	:	can be used as trigger inputs	
Operating Conditions	:	**Temperature**	
		Operation	0 to 45°C
		Storage	-25 to 55°C
		Transport	-25 to 55°C
Power Supply	:	Input voltage	24 to 64 VDC ±25%
		Inrush current	Max. 10 A
		Power consumption	
		Idle (no motor powered)	0.5 W
		Continuous power consumption	1.31 kW
Switching threshold	:	Low	<5 VDC
		High	>15 VDC
Switching delay	:	Rising edge	[Instant recording] Typ. 52 µs
		Falling edge	[Instant recording] Typ. 53 µs
Motor Connection	:	Quantity	2
		Nominal current	Up to 20 kHz: 8 ARMS / 11.3 APeak At 40 kHz and greater than 45°C: ARMS / 9.2 APeak
		Max. current/motor	10.6 ARMS / 15 APeak
		Max. current/module	30 APeak
		Nominal switching frequency	5 kHz
		Possible switching frequencies	5 / 10 / 20 / 40 kHz
		Max. motor cable length	25 m
		Controller frequency	20 kHz
		DC bus capacitance	940 µF

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Table 3: Specification of Motors 8LVA13.B1030D000-0

Name of Property		Details	
Application	:	can be used as trigger inputs	
Number of pole pairs		4 pairs	
Motor		Nominal speed nN [rpm]	3000
		Number of pole pairs	4
		Nominal torque Mn [Nm]	0.320
		Nominal power PN [W]	101
		Nominal current IN [A]	1.400
		Stall torque M0 [Nm]	0.360
		Stall current I0 [A]	1.600
		Maximum torque Mmax [Nm]	1.00
		Maximum current Imax [A]	5.20
		Maximum speed nmax [rpm]	6600
		Torque constant KT [Nm/A]	0.230
		Voltage constant KE [V/1000 rpm]	13.61
		Stator resistance R2ph [Ω]	5.800
		Stator inductance L2ph [mH]	10.20000
		Electrical time constant tel [ms]	1.800
		Thermal time constant ttherm [min]	15.0
		Moment of inertia J [kgcm2]	0.0300
		Weight without brake m [kg]	0.60
Holding Brake	:	Holding torque of brake MBr [Nm]	0.35
		Mass of brake [kg]	0.10
		Moment of inertia of brake JBr [kgcm2]	0.0130

VII. SOFTWARE SPECIFICATION

Table 4: Specification of B&R Automation Software

Name of Property		Details
Application	:	A single uniform programming tool for every aspect of an automation project minimizes training needs, solidifies overall integration and eliminates communication problems between engineering disciplines.
Software version	:	B&R Automation Studio 4.10.2.38
Ram	:	Min 4 GB recomn

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Table 5: Specification of Scence Viewer Software

Name of Property		Details
Application	:	To run Simulation
Software version	:	Scene Viewer 4
Ram	:	Min 4 GB recomn

VIII. HARDWARE IMPLEMENTATION

Introduction

DELTA data the robot has attracted a lot of attention from both academics and industry. Books contains a wealth of information on the history and types of similar robots. Generally, the DELTA robot consists of an equilibrium base, with one arm (working with a revolute joint) from each side. A small, triangular travel plate is attached to each arm with parallelogram-shaped arms. The result is three free translation levels, and one additional uninterrupted version The rotating degree of freedom in the end, which leads to the focus of a single car base and connected to the end by a telescopic arm with two universal members. Performance testing is an important issue for good robot design within activity cells.

The literature suggested analysing the performance of several robots Operating Blocks Figure 4.1 Using the Hardware X20CP1586 CPU Controller In for this project we used 1 CPU X20CP1586 Controller; The X20CP1586 is powerful X20 CPU system. This CPU is especially useful for programs that require short cycle times, should process large amounts of data or perform floating point functions. The clock is off 1.6 GHz also has 512 MB DDR2 SDRAM Opens when we use Power Parameter in Automation Studio. PLC Drives (80VD100PD.C000-01) 2 PLC Drives Connected to CPU used as trigger inputs, its A PLC is an Industrial Computer Control system continuously monitor the status of input devices and make decisions based on a custom system to control the situation synchronous motors connected to the PLC Synchronous Motor 8LVA13.B1030D000-0 is Industries that take advantages of the high speed of delta robots are the packaging industry, medical industry and manufacturing. Motor are the primary mechanisms by which robotic arm or Axes move. When PLC gives input to synchronous motors it's started moving all axes according to the CPU Program input.

IX. SOFTWARE IMPLEMENTATION

Introduction

The Delta Robotic Automation Studio (DRA Studio) controls all of Delta's articulated robots. Select your robot type and model for further configuration (see the screenshot below). The robot types Delta Robot Automation Studio and indicate 4-axis / 3-axis / 5-axis robots respectively, while VA indicates 4-axis circulated robots. In this project, the robot in the middle of the machine will be controlled by a specific process using Mapp Robotics and HMI screen will upgrade the robot. 4 Axis Delta Robot automation done in B&R Automation Studio 4.10.2.38. B&R is Very user-friendly software for robotics automation.

Simulation for 4 Axis Delta Robot is done in B&R Scene Viewer 4. For HMI Development done in B&R HMI Software. For example, the manipulator of the robotic arm will trace 'B&R'. Operator can control the robot automatically and manually by giving commands 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.

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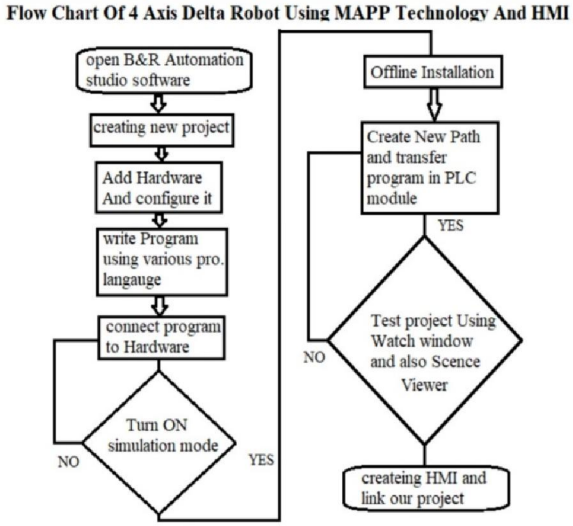
Flowchart (Working of Modules)



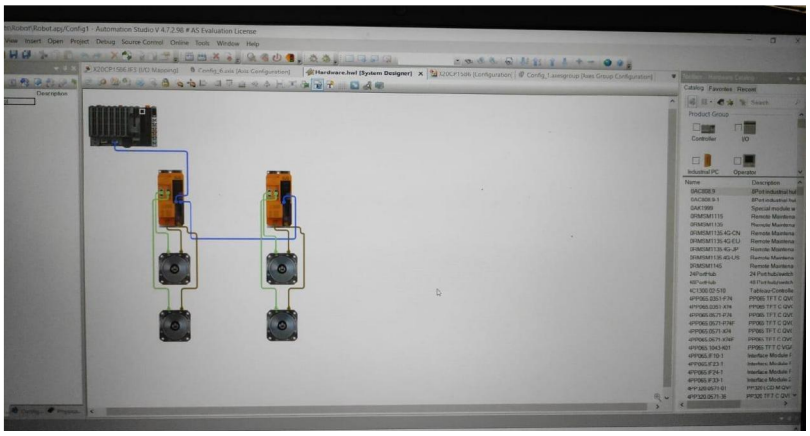


Figure 5.1: Implementation on Automation Studio

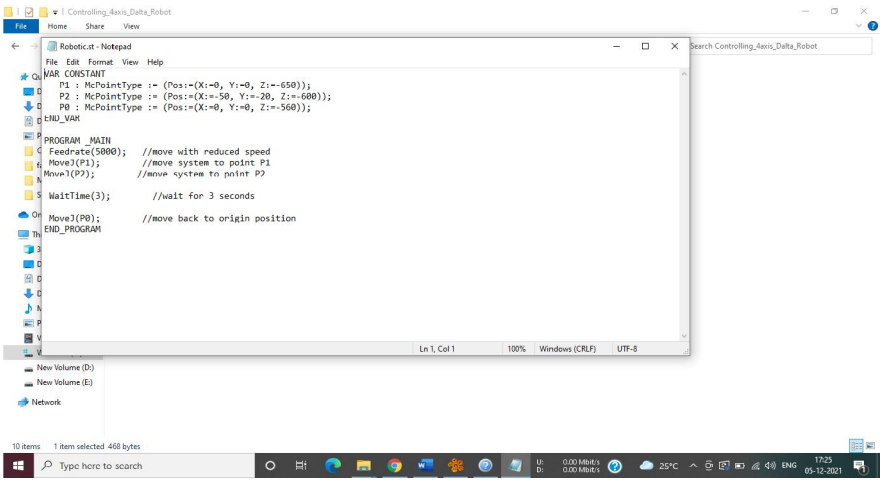


Figure 5.2: External C Drive Program

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X. IMPLEMENTATION OF 4 AXIS DELTA ROBOT USING MALL TECHNOLOGY AND DEVELOPING HMI

The DELTA robot has attracted much attention in both academia and industry. I the books contain a wealth of information on the history and types of similar robots. typically, the DELTA robot consists of an equilateral base, with one arm (activated by a rotating joint) from each side. Small, triangular motion the plate is attached to each arm with parallelogram-shaped arms. The result is three degrees of translation freedom, and one additional degree of rotation not included of freedom in the end, which results in one engine being focused on the base as well connected to the end by a telescopic arm with two universal members. Performance testing is an important issue for good robotics in the workplace cells.

The literature suggested analysing the performance of several robots. X20CP1586 CPU Controller In this project we used 1 CPU X20CP1586 Controller the X20CP1586 is a powerful X20 system CPU. This CPU is especially useful applications that require short cycle times, should process very large amounts of data or do floating activities. The clock is 1.6 GHz and has 512 MB DDR2 SDRAM Opens when we use Power Parameter in Automation Studio. PLC Drives (80VD100PD.C000-01) 2 PLC Plugs Connected to the CPU used as trigger inputs, A PLC is an Industrial Computer Control system that continuously monitors the status of input and decision-making based on a custom program to control situation synchronous motors connected to the PLC. Synchronous Motor 8LVA13.B1030D000-0 Industries that take advantages of the high speed of delta robots are the packaging industry, medical industry and manufacturing.

Motor are the primary mechanisms by which robotic arm or Axes move. When PLC gives input to synchronous motors it's started moving all axes according to the CPU Program input. The Delta Robotic Automation Studio (DRA Studio) controls all of Delta's articulated robots. Select your robot type and model for further configuration (see the screenshot below). The robot types Delta Robot Automation Studio and indicate 4-axis / 3-axis / 5-axis robots respectively, while VA indicates 4-axis circulated robots. this project, the intermediate robot will be managed through a process using Mapp Robots and HMI screen will be upgraded with a robot. 4 Axis Delta Robot automation is done at B&R Automation Studio 4.10.2.38. B&R is a very easy-to-use software for robotic automation. Model 4 Axis Delta Robot made in B & R Scene Viewer 4. With HMI development done in B & R HMI Software. For example, a robotic arm will follow 'B & R'. Operators can control the robot automatically and manually by giving instructions via HMI again. This robot will perform tasks on the basis of g-code, m-code and n-code (CNC type programming) written in system.

XI. RESULTS

Performance evaluation is important for optimal robot positioning within a workspace. To evaluate the performance of the developed DELTA robot, a measurement set-up is built. A repeatability test is carried out to ensure the accuracy of the robot system. This positioning accuracy is close to that of an equivalent commercial robot. These results reveal that the robot system is reliable. Automation studio can provide to write a program in various ways so in our project we can write a program in external source from c drive in this program in we can make program to draw a triangle and when we can give its name in our main program or is path is declared in AS Software. we can easily access this this program in our automation studio. so, when we can create simulation mode. (It is basically we Create Copy of Hardware in our Laptops or desktop. And it is worked as a runtime Hardware.) In this process we can use SCENCE VIEWER Software.

When we can create delta robot in Scence Viewer and we can give its axis values declared in our main program after declaration we Connect both Automation Studio and Scence Viewer by Using OPC UA connect Method in which We use BnR Automation runtime server name is BnR Embedded OPC -UA Server and Client. Then after We Put Automation studio in Simulation mode and when we open "Watch Window" And Set Following Value, Power -True, Home – True, Move Program – True. Our 4 axis Delta robot Starting to Move and Draw a Specific Diagram Respectively Declared in our Main program. Basically, in our program we Creates Triangle Draw Program. And we also change program directly changing axis values of Delta Robot on HMI.

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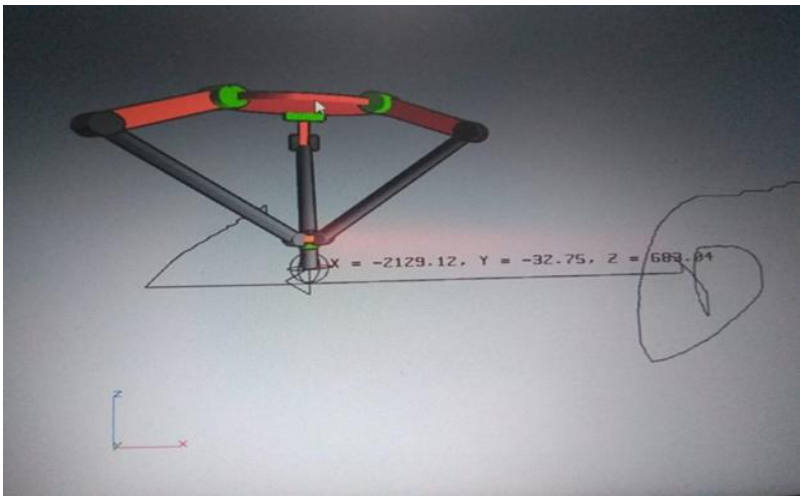

Figure 6.1: Simulation of Project on Scence viewer

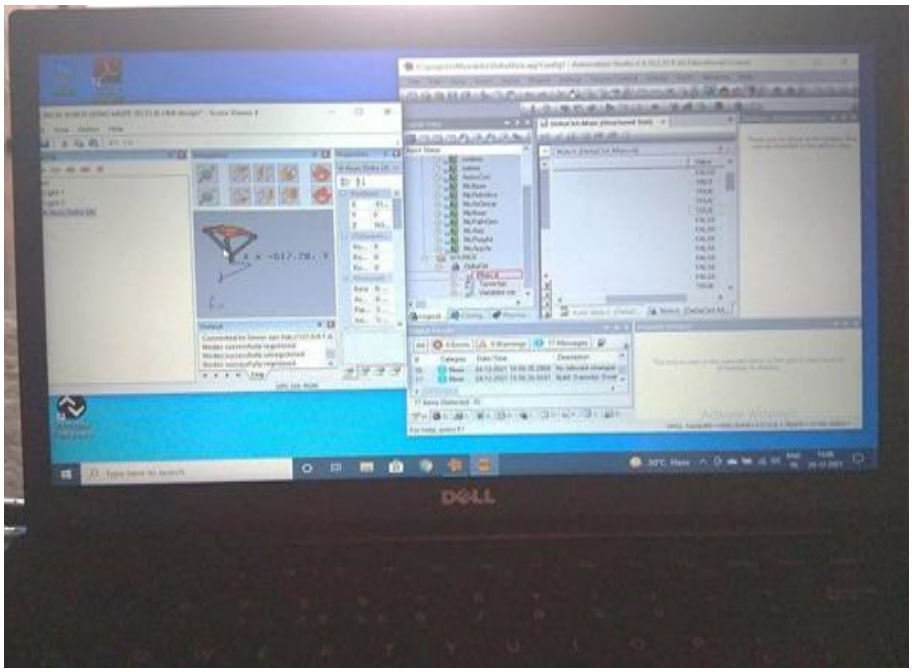

Figure 6.1: Result of Project on Scence viewer

XII. CONCLUSION AND DISCUSSION

This work introduces a design of a DELTA robot with an end-effector for performing multifunctional operations and provides insight into the way this academic innovation has been transformed into a mechatronic kit for education. The design of the proposed DELTA robot includes the 2-axis rotation of the wrist, a gripper, and a 4-axis robotic arm. The robot system's implementation involves the development of the mechanism, both its hardware and software.

XIII. FUTURE SCOPE

In the future, we use mainly this 4-axis delta robot in industrial work for packaging or picking and also Designing and Developing new Designs and Cutting metals in well Shapes. it is the best investment for Upcoming companies.

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