Lab Manual

Industrial Robotics and Automation

Experiment No:1 Understand Robot Work cell

Aim: To list down the components present in a robot work cell. Write down the functionality of each component

Description:

A robot work cell typically consists of several components designed to facilitate the automation of a specific task or process. These components can vary depending on the specific application and requirements, but here are the common components found in a typical robot work cell:

Robot: The central component of the work cell, robots are programmable machines capable of carrying out various tasks with precision and repeatability. They come in different types such as articulated, SCARA, delta, etc., depending on the application requirements.

End Effector: The end effector is the device attached to the robot arm that interacts directly with the workpiece or the environment. Grippers, suction cups, welding torches, and other tools are examples of end effectors.

Safety Systems: Safety is paramount in any industrial setting involving robots. Safety systems may include fencing, light curtains, interlocks, emergency stop buttons, and safety mats to protect human operators and prevent accidents.

Control System: This includes the robot controller, which manages the robot's movements and operations. It may also include PLCs (Programmable Logic Controllers) or other automation controllers responsible for coordinating various components within the work cell.

Sensors: Sensors are used to provide feedback to the robot or the control system. They can include proximity sensors, vision systems, force/torque sensors, encoders, and other types of sensors to ensure accurate positioning, detect objects, or monitor process variables.

Workpiece Fixturing: Fixturing and positioning devices hold the workpiece securely in place during the robot's operation. This can include jigs, fixtures, conveyors, turntables, or other mechanisms to present the workpiece to the robot in the correct orientation.

Human-Machine Interface: An interface for human operators to interact with the robot work cell. This can be a touchscreen panel, a computer interface, or other devices allowing operators to monitor the process, input commands, and troubleshoot issues.

Power Supply and Distribution: Robots and associated equipment require electrical power. A power distribution system ensures that the necessary power is supplied to all components safely and reliably.

Material Handling Systems: In some cases, material handling systems such as conveyor belts, robotic arms, or automated guided vehicles (AGVs) may be integrated into the work cell to transport materials to and from the robot for processing.

These components work together to automate tasks efficiently and safely within the robot work cell.

Note: *Students are requested to list down the components in the robot work cell and their functionality*

Result: All the components in the Robot Work cell have been listed and described briefly

Experiment No:2 Perform Robot Jogging using Virtual Teach Pendant

Aim: To Perform Robot Jogging using Virtual Teach Pendant in ABB Robot Studio.

Procedure/Steps:

Step 1: Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Import and place a concrete from import library.

Step 4: Click ABB Library select "IRB 1410".

Step 5: Click on the virtual controller. Add controller by selecting From Layout option

Step 6: Check for the controller status to be in green

Step 7: Position the robot above the concrete.

Step 8: Click on import library select "my tool" and attach the tool to the robot.

Step 9: Click on the controller menu

Step 10: Click on the Flex pendant icon

Step 11: In virtual flex pendant click on the "Enable" and "Hold to run" buttons near the joystick

Step 12: To change the motion mode, click on the Motion mode selection button near the joystick.

Step 13: Click on the Axis selection button to change to the joint jogging mode.

Step 14: Now click on the arrow marks on the joystick of the virtual Flex pendant to move the robot.

Result: Thus, Robot jogging using virtual tech pendant is executed successfully.

Experiment No:3 Perform online programming using the virtual teach pendant

Aim: To perform online programming using Virtual Teach Pendant in ABB Robot Studio.

Procedure/Steps:

Step 1: Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Import and place a concrete from import library.

Step 4: Click ABB Library select "IRB 14".

Step 5: Click on the virtual controller. Add controller by selecting From Layout option

Step 6: Check for the controller status to be in green

Step 7: Position the robot above the concrete.

Step 8: Click on import library select "my tool" and attach the tool to the robot.

Step 9: Click on the controller menu

Step 10: Click on the Flex pendant icon

Step 11: In virtual flex pendant click on the "Enable" and "Hold to run" buttons near the joystick

Step 12: Click on Main menu drop down in the virtual flex pendant.

Step 13: Click on the program editor menu.

Step 14: In program editor window click on "Add instruction"

Step 15: Insert a Move J instruction,

Step 16: Now click on the arrow marks on the joystick of the virtual Flex pendant to move the robot and position the TCP to the required point.

Step 17: Repeat step14 and 15, to create motion commands

Step 18: Position the robot in the required targets and insert the require motion instruction.

Step 19: Once the programming is completed, click on debug option.

Step 20: Click on PP to routine in debug window.

Step 21: select the routine in which the program is written.

Step 22: When the routine is loaded, click on the next button in the teach pendant to verify the robot motion step by step.

Step 23: After checking click on the Play button in the teach pendant to run the program continuously.

Result: Thus, online programming using virtual flex pendant is executed successfully.

Experiment No:4 Creating Paths and Targets for Writing the First Two Letters of Your Name in Robot Studio

Aim:

To create paths and targets for writing the first two letters of the name in ABB Robot Studio

Procedure/Steps:

Step 1: Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Import and place a concrete from import library.

Step 4: Click ABB Library select "IRB 1410".

Step 5: Click on the virtual controller. Add controller by selecting From Layout option

Step 6: Check for the controller status to be in green

Step 7: Position the robot above the concrete.

Step 8: Click on import library select "my tool" and attach the tool to the robot.

Step 9: Go to modelling select "Solid" then select "Box", Enter length=900mm

Width=900 mm & height=30 and click "create".

Step 10: Right click on the robot in layout tab. Click on show work envelope.

Step 11: Position the created work object in the required place.

Step 12: create targets for writing the Letters.

Step 13: create path by connecting the targets in required sequence.

Step 14: create simulation entry points.

Step 15: synchronize the station to rapid.

Step 16: click on simulation play button.

Result:

The paths and targets for writing the first two letter of the name in ROBOT STUDIO was created and simulated successfully.

Experiment No:5 Creating a Robot Work Cell for Dispensing Process in Robot Studio.

Aim:

To create a robot work cell for dispensing process in ABB Robot Studio.

Procedure/Steps:

Step 1 : Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Import and place a concrete from import library.

Step 4: Click ABB L ibrary select "IRB 1520".

Step 5: Click on the virtual controller. Add controller by selecting From Layout option

Step 6: Check for the controller status to be in green

Step 7: Position the robot above the concrete.

Step 8: Click on import library. Click on browse for library. Browse and locate the dispensing tool.

Step 9: Select and import the Tool.

Step 10: Attach the Tool to the Robot.

Step 11: Click on import geometry. Click on browse for geometry. Browse and locate the table with door part.

Step 12: Import table with door and position it within work envelope of the robot.

Step 13: Create target around door for dispensing.

Step 14: Create path by connecting the targets in required sequence.

Step 15: Create simulation entry points.

Step 16: Synchronize the station to rapid.

Step 17: Click on simulation play button.

Result:

The robot work cell for dispensing process is created and the process simulated in ABB Robot Studio.

Experiment No:6 Creating a Robot Work Cell for Material Handling Process in Robot Studio.

Aim:

To create a robot work cell for material handling process in ABB Robot Studio.

Procedure/Steps:

Step 1 : Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Import and place a concrete from import library.

Step 4: Click ABB L ibrary select "IRB 2600".

Step 5: Click on the virtual controller. Add controller by selecting From Layout option

Step 6: Check for the controller status to be in green

Step 7: Position the robot above the concrete.

Step 8: Click on import library.

Step 9: import "ABB smart gripper" from import library.

Step 10: Attach the Tool to the Robot.

Step 11: create two square pillars in "solid" on modelling.

Step 12: create cylindrical object in "solid" on modelling.

Step 13: create the simulation action for the "smart gripper" in "smart components" tab.

Step 14: create I/0 signal in controller for the opening and closing of gripper.

Step 15: create targets "home, intermediate, pick offset, pick, drop offset, drop".

Step 16: create path using "created targets" in sequence.

Step 17: Add the instructions for opening and closing of gripper in the program.

Step 18: Synchronize the station to rapid.

Step 19: click on simulation play button.

Result:

The robot work cell for material handling process was created and simulated using ABB Robot Studio.

Experiment No:7 Creating a conveyor tracking process using power pack in robot studio

Aim:

To create a robot work cell for performing conveyor tracking in robot studio

Procedure/Steps:

Step 1 : Open ABB Robot Studio software.

Step 2: Create new empty station.

Step 3: Click ABB Library and select "IRB 2600".

Step 4: Import my tool from import library

Step 5: import a conveyor model to the station from import library

Step 6: create controller from virtual controller

Step 7: select from layout option

Step 8: In summary window, click on option

Step 9: Select conveyor tracking I motion coordination menu, then click on finish and let the controller load

Step 10: Now, attach the tool to the robot

Step 11: Create conveyor mechanism from modelling menu

Step 12: Create connection and add parts to the conveyor mechanism

Step 13: Position the part on the conveyor

Step 14: Perform path planning for object tracking

Step 15: Insert action instructions for activating conveyor and for the work objects

Step 16: Create a simulation entry point

Step 17: Synchronize the station to rapid.

Step 18: click on simulation play button.

Result:

The robot work cell for Conveyor tracking was created and simulated using ABB Robot Studio.

Experiment No:8 Creating a Picking Process Using Power Pack in Robot Studio

Aim: To create a picking and packing process simulation in ABB robot studio using Powerpac

Procedure/Steps:

Step 1: open app robot studio

Step 2: create new empty station

Step 3: import IRB 360 from ABB library

Step 4: offset the robot 1600 mm in Z axis.

Step 5: click on virtual controller and select from layout.

Step 6: select Robot ware and click next

Step7: Select mechanism and select next

Step8: click on options in summary window.

Step 9: select packaging from categories

step 10: under prepared for pick master and Power Pac. enable pick master 3.

Step 11: select two conveyor work area under conveyor configuration

Step 12: select one I/o board device net.

Step 13: click OK

Step14: Click finish in controller options

Step 15: Go to add ins and Select Picking

Step 16: add two conveyors form Add conveyor option

Step 17: Position the Conveyors such that the robot is at the middle of two conveyors.

Step 18: Click on add picking controller option and select the controller listed. and click OK.

Step19: Click on add picking tool option and select the tool

Step 20: Click on add work area option. Customize the conveyor work area based on the requirements.

Step 21: Click add senor option

Step 22: Add a vision sensor to the conveyor 1 and a plane sensor to the conveyor 2.

Step 23: Click on “Add flow handler”

Step 24: In item detection, Select add camera for distance trigger. And map it to conveyor 1.

Step 25. Again, click on “Add flow handler”

Step 26: In item detection, In I/O section select the I/O sensor and map it to conveyor 2.

Step 27: Click on Item/container option.

Step 28: Add item and item container and specify its size and click apply and close.

Step 29: Click on the Container pattern option

Step30: Add the selected item and container. And create a pattern layout.

Step 31: Click on Job

Step 32: Click on add Job. Add the item and Container pattern select and click ok.

Step 33: Click on calibrate and select Quick Calibrate.

Step 34: Click on Start button and check the simulation window.

Result: Therefore, we have performed Picking operation using parallel robot in ABB Robot studio

Experiment No:9 Simulating a 3d Printing Process using Powerpac

Aim: To create a 3D printing process simulation using ABB robot studio.

Procedure/Steps:

Step 1: open ABB robot studio

Step 2: create an empty station

Step 3: go to controller menu and click on installation manager. Select installation manager 6

Step 4: Add new virtual controller and click next

Step 5: in product tab click add and select three DP. Click OK

Step 6: go to options tab go to drive modules. Select a robot from the list. Click next.

Step 7: click apply.

Step 8: go to AB library and select the robot choose in controller

Step 9: import pen tool from import library

Step 10: click on virtual controller on select existing controller.

Step 11: Select the controller created for 3D printing

Step 12: attach the tool to the robot

Step 13: create a worktable and position it.

Step 14: Create new work object

Step 15: in create work object window. Define frame position using three-point and click on create.

Step 16: go to add-ins and select 3D printing.

Step 17: in 3D printing menu click open G code option

Step 18: select a G code file, then click open

Step 19: in import g code file, enable active checkbox. And click import

Step 20: reposition the work object by using modify work object option in parts and targets window

Step 21: after repositioning the work object click on refresh button under preview tab.

Step 22: check the work object after repositioning

Step 23: click on the instruction line displayed at the bottom of Robert studio window

Step 24: in instruction template window select PrintL command

Step 25: click on target orientation

Step 26: enter the values in the rotation axis columns so that the tool is aligned like it is attached to the robot

Step 27: click on process. In process setting window click process drop down on select dispense lean

Step 28: click on process motion mode drop down and select accuracy mode

Step 29: change the speed to V500

Step 30: Change zone process intermediate to fine and click close

Step 31: click on check reachability. Select any configuration and click apply. Wait for the system to check the reachability

Step 32: click on export program. Enter your name for the file and click export

Step 33: jump the robot to home position and click on simulation play button.

Step 34: go to file menu click on save.

Result: Therefore, we have built a 3D printing robot work cell and simulated the process

Experiment No:10 Programming ABB IRB 2600 For Material Handling Process Using Online Programming

Aim: To create a material handling process using online programming

Procedure/Steps:

Step 1: switch on the robot

Step 2: click on the dropdown in the main window of the teach pendant

Step 3: select program editor

Step 4: click on routines on the top right of the program window

Step 5: click on “file” in routines window and select new file option.

Step 6: Type a routine name in the routine declaration window and click OK at the bottom of the window.

Step 7: click on show routine

Step 8: Click on Add Instruction

Step9: create program by adding MoveJ, MoveL and MoveC instructions from the list.

Step 10: Teach Home intermediate, Offsets, Drop, and Pick up points adding the appropriate instructions

Step 11: Add action instructions like Set DO and Wait time in necessary steps.

Step12: Click on Debug

Step 13: Select “PP to routine”

Step14: In select routine window, select the required Routine and Click ok

Step15: Run the instructions one by one, by clicking “next” button in the teach pendant.

Step16: Once the check is over repeat step 12, 13, and 14. And click play button

Result: Therefore, we have operated ABB IRB 2600 robot and performed online programming using Flex Pendent