

PRODUCT SPECIFICATION

Robo Shop	DATE	REV
Product Requirements	19 June 2019	0

Project Robo Shop Product Requirements

Robo Shop
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Document History

Rev Number	Date	Modified By	Reason
0	19June2018	J. Khohl S. Alhajri M. Alessa	Initial Release

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1 Objective

The objective of this document is to document the requirements of the project as specified by the lead instructor (Dr. Beyerlein) and client (Ankit Gupta) and agreed upon by the team members.

Our mission is to integrate a two robot system into a miniature assembly line, in order to make a product involving operations of barcode scanning, part manipulation, sorting, fixture design, and supervisory control and a screwing process.

2 Scope

The scope of this document is to define each requirement of the project. Each requirement shall be explicitly stated to ensure they are met.

3 References

3.1 Cited Documents

“Products.” Training Courses Available at DENSO Robotics, densorobotics.com/products/vs-g-series/download-materials. (Manuals for the Denso Robotic Arms)

“Robotic Arm Manufacturing Cell.” Cutter Types (Mill) - Mindworks, mindworks.shoutwiki.com/wiki/Robotic_Arm_Manufacturing_Cell. (Previous Robot Manufacturing Cell Group Project)

“Denso RC7M Manuals.” Manuals Library, www.manualslib.com/products/Denso-Rc7m-8883395.html. (Operating manuals for the Denso Robotic Arms)

WINCAPS III (Program used to write code and simulate the function of the robot)

Davison, Pat. Safety Standards and Collaborative Robots, www.robotics.org/userAssets/riaUploads/file/6-Pat.pdf.

(Safety Standards for Robots)

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Murashov, Vladimir, et al. "Working Safely with Robot Workers: Recommendations for the New Workplace."

Advances in Pediatrics., U.S. National Library of Medicine, Mar. 2016,
www.ncbi.nlm.nih.gov/pmc/articles/PMC4779796/. (Safety Recommendations for Industrial Robotics)

"Language Reference." Arduino - Introduction,
www.arduino.cc/reference/en/.

"Robotic Manufacturing Cell Capstone:" http://mindworks.shoutwiki.com/wiki/Robotic_Manufacturing_Cell

3.2 Acronyms

EPO Engineering Purchase Order

ER Engineering Release

POC Proof of Concept

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4 Functional Requirements

4.1 *User Interface Requirements*

The assembly must be self-functioning, or automated. The only user involvement shall be to start the process. In case of malfunction, emergency stop switches are in place: one on each controller and one on the outside of the cell.

4.2 *What it should do*

This is an automated assembly line, where the two robotic arms communicate with each other via TCP/IP protocols to complete a task. The first robot utilizes a gripper to grab objects and scans them over the bar code to identify their shapes. Once identified, the objects will be placed in their specific location, the same robot will also grab screws and place them on the objects. The other robot will utilize a screwdriver to fasten the screws.

5 Mechanical Requirements

5.1 *Strength Requirements*

The robotic arm has a limitation of 5-7 kg load.

The operating air pressure is .1 - .39 MPa. The max air pressure is .49 MPa.

5.2 *Spatial Requirements*

The assembly line shall fit within the space provided in the manufacturing cell. This area is a 2438.4 mm x 1835 mm rectangle (X vs Y). Due to limitations on the arm with University of Idaho serial number 196-549, the negative XAxis must not exceed a length of 762 mm. Each arm shall have an initial/rest position to avoid potential collisions. Each part must have its own location in the cell, one side shall be where the robot gathers the part, the other shall be where it distributes the final product. Each storage location shall be specified via the code for the robot.

5.3 *Weight/Mass Requirements*

The maximum mass allowed by the end of the robotic arm shall be 5 kg.

5.4 *Mounting / Interface Requirements*

The “widget” shall mount to the “doo-hickey” using the following bolt pattern:

Image

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5.5 Appearance Requirements

There will be three templates, circular, rectangular, and hexagonal. Specific measurements will be up to the team specified at a later date.

5.6 Durability Requirements

The system shall be designed to continuously work, without any human interaction, until the process has ended. Each of the different shapes will be moved and have screws fastened on them once.

5.7 Reliability Requirements

The robots must be programmed to avoid collisions with each other, as well as the surroundings. Due to limitations on the arm with University of Idaho serial number 196-549, the negative X-Axis must not exceed a length of 762 mm in order to not collide with the wall. After each arm completes a task, they will return to a pre-specified origin point to avoid collision with the other. If necessary, multiple emergency stop switches are in place to shut down the program: One on each controller, and one on the outside of the manufacturing cell.

The scanner should be able to read the barcodes of each object, due to the incapability of getting the exact position of the barcode correct, the barcode must be able to be read no matter the angle of orientation of these objects.

6 Electrical Requirements

6.1 Operational Voltage

The Denso robots will have an AC200-230V power limit. The voltage range of the stepper controller must be between 20-50VDC. For the Arduino, a range of 7-12VDC is required..

6.2 Operational Power Capability

Each axis has a different power limit.

Axis 1 – 750 W
Axis 2 – 400 W
Axis 3 – 200 W
Axis 4 – 100 W
Axis 5 – 80 W
Axis 6 – 50 W

6.3 Energy Storage Capacity

The storage capacity of the equipment shall be the sum of the power of the 6 axes working together. In total, this should be 1.58 kWh.

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7 Software Requirements

7.1 *Functionality*

We will be using WINCAPS III, Solidworks, and Arduino.

7.2 *User Interface*

The robot will be controlled through WINCAPS III software via the controller. Using the specified controller for each robot, a unique code will program the robot after inputting through the unique IP Address of each robot.

For the Arduino, a laptop is required to monitor the serial output in order to determine whether the Arduino is connected via IP address to the scanner.

8 Environmental Requirements

8.1 *Temperature*

The robot is expected to be utilized from 0-40 °C and to be maintained under 90% RH. The stepper controller must be utilized in a temperature range of -10-45 °C.

8.2 *Environmental Sealing*

The manufacturing cell must be surrounded by a wall, to promote the safety of the workers. An emergency stop switch will be located outside of the walls, to kill the program if required.

9 Regulatory Requirements

9.1 *UL Requirements*

ISO 10218-1:2006 - Standards for Robots, Robot system/cell and application ISO TS 15066 – Technical Specification Standards on Robots ANSI/RIA R15.06-2012 – American National Standard for Industrial Robots and Robot Systems ISO 10218-1:2011 – Standards for Robots, Robot system/cell and application ISO 10218-2:2011 – Standards for Robots, Robot system/cell and application

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9.2 Shipping Requirements

Standard shipping for parts will be used unless absolutely necessary.

This is a stationary product and will not be shipped elsewhere.

10 Cost Requirements

10.1 Prototype Cost

Cost requirements for materials shall not exceed 500\$.

11 Schedule Requirements

The following are the major Project Milestones:

- Approval of Requirements June. 24, 2019
- Concept Design Review July 25, 2019
- EPO of long lead parts Aug. 1, 2019
- Detailed Design Review Aug. 2, 2019
- ER of drawing package Sept 27, 2019
- Complete Prototype build Nov 22, 2019
- UI Design EXPO Dec 6, 2019
- Final Report / Drawings Dec 13, 2019