SkillsUSA
2012 Contest Projects

Robotics and Automation Technology

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.

5: Competition Introduction

5.1: The Client

SCORBOT Robotics, Inc. has been providing high quality affordable structural blocks for commercial and consumer use since 1959. As our business grows, so does our need to become more efficient and cost-effective in our manufacturing facilities. We see a future cost and quality benefit in the automation of our production process, and we desire a robotic workcell to manufacture our structural blocks.

5.2: Supplied Equipment and Materials

Our corporation will be providing automation hardware to all firms competing for our business. The hardware specifications are listed in the documentation that has been provided.

These workcell components are:

1. Computer with SCORBASE software
2. ER-4u robot, Controller, Controller Interface, and Cables
3. Teach Pendant
4. Linear Slide Base
5. Conveyor with photo-sensor
6. Electro-Pneumatic Parts Feeder with part in stack switch and part in place switch
7. Electro-Pneumatic Press with cylinder position sensors
8. Interface Board for all Input and Output connections
9. Stack lights (Red, Green, Blue and Yellow)
10. Storage area
11. Sensor station with proximity switch and micro switch
12. Bad parts bin
13. Emergency stop switch
14. Blocks, structural, of varying materials
15. Power Terminal strip
16. E-Stop switch
17. Power strip and extension cord
18. Task assignments
19. Notebook
20. Mounting platform
21. Pressurized air supply for pneumatic equipment operation
22. **Siemens Programmable Logic Controller (PLC with program)**

5.3: Additional Supplied Hardware Information

SCORBOT Robotics, Inc. is supplying you ER4u robots, mounted on Linear Slide Bases in the center of work platforms. This provides a work envelope on either side of the slide base. The controller has been placed on the platform with the Controller Interface. The Emergency Stop switch and Stack Lights are attached to the rear corner while the Teach Pendant is on the front corner of the platform opposite the controller. All remaining hardware may be placed on the platform at your discretion to enable efficient implementation of your solution. As you plan the placement of these hardware items, your system proposal should provide for future expansion to allow the system to add more features and capabilities for future task designs.

5.4: Specific operational requirements:

The following operational requirements shall be implemented on all team proposals. These requirements are essential for successful completion of each task level.

Stack Lights:

Before any robot motion, and for certain other actions, safety warnings must be given. The Stack Lights will be used to signal safety conditions. Illumination of the appropriate light at the proper time is essential. As events occur, the Stack Lights must illuminate the proper color to indicate the event. See Stack Light Usage Section for all signal requirements.

Parts Counters:

Both good and bad parts must be counted. Plastic and Metal counts must both be counted separately. Refer to each task level requirement in each section for specific counting and count logging requirements. The counters must be displayed with the PrintToScreenLog command.

The Counters must be displayed with the PrintToScreenLog command.

5.5: Evaluation

The competition has been split into 2 separate tasks, each task building on the prior task. When your team has completed the design for the workcell, you will notify a representative from SCORBOT Robotics Inc. to review your proposed solution. This design must include the workcell layout and appropriate documentation.

Once approved, you will receive a green tag, allowing you to complete the operational phase of the task. Once you are ready with the operational phase, you will notify a representative from the SCORBOT Robotics Inc. to review the operation of the workcell.

SCORBOT Robotics Inc. will use the following criteria during the initial interview to evaluate your proposal for each task:

- Team is ready to discuss proposal and implementation.
- Both team members active in discussion.
- Safety issues documented.
- Flow chart documentation is complete.
- Hardware layout documentation complete.
- I/O documentation complete.
- Robot Positions documentation started

For the operational phase of the task, SCORBOT Robotics Inc. will review the following:

- Hardware layout matches documentation.
- Wiring connections match documentation and is neat and organized.
- Flow chart aligns with program.
- Operational phase will be judged.
  - ✓ Have all parts available for judges to select loading order.
  - ✓ Wait for judge to arbitrarily select the order parts are to be loaded into the parts feeder.
  - ✓ A Judge will load the parts.
  - ✓ When instructed by a judge you will nm the program.
- Stack Light Operation
- Part Testing
- Part Feeder Operation
- Part press Operation
- Part placement
- Ready to discuss Implementation
- Both Members Active in discussion

6: Task One

6.1: Overview

SCORBOT Robotics Inc. is currently seeking a firm that can provide the most efficient automation solution through written proposal and demonstration.

Your team's assignment is to assess the requirements of the Task One specifications and then to develop a proposal on how you plan to accomplish this task. This proposal must include the appropriate documentation for SCORBOT Robotics, Inc. to review in order for your team to gain the judge's approval to build and program the proposed system.

6.2: Evaluation

When your team has completed the design for the workcell layout and the appropriate documentation, notify a representative from SCORBOT Robotics Inc. (Judge) to conduct a review of your proposed solution. Once approved, you will be provided a power cable to complete the work cell hardware for demonstration to the judges.

6.3: Required Documentation

SCORBOT Robotics Inc. managers want to see a complete and full proposal that will include all schematics, flow-charts, drawings, layouts, and request a meeting with the vendor before the demo is setup and run.

1. Proposed System layout for the specified task.
   a. Hardware Layout (Drawing).
   b. Robotic Interface – Input and output connections.
   c. PLC Connections
   d. Peripheral hardware connections.
2. Flow chart of proposed robotic program.
3. Any additional supporting documentation as required.

6.4: Initialization:

The plastic and metal blocks will be placed in the "automated parts feeder" in random order the holes facing up. When the parts feeder is activated, a block will be pushed out of the shoot, and will activate (press) the micro switch. The robot should wait for the specified amount of time after the block is in place. Use an assortment of all 8 available blocks. The blocks will be placed with the holes up. Remember, a contest judge will be placing the blocks in the feeder in random order during judging.

6.5: General Task Description

SCORBOT Robotics Inc. wants to automate a "hole" punch operation and quality inspection for our model A, plastic and aluminum blocks. The feeder is equipped with multiple switches to detect when the feeder stack is empty and when a block is in position for robotic pick-up. This will require the system to monitor the automated parts feeder stack for the presence of a block (Block loaded in the feeder stack). The system will then use the air cylinder to feed a block out of the feeder stack, where it will activate a sensor to notify when a block is in position for robotic pick-up. The robot will then take the block from the automated parts feeder, punch a hole in it, inspect the hole and determine whether the hole punch process was successful and the block has a hole. Blocks without holes are to be considered "bad" or "failed" blocks.

Cycle time is again very important to SCORBOT Robotics Inc. After a full cycle has been run, a second test will be run to track cycle time. Cycle time will be counted on a final run of 4 blocks, one of each type with and without a hole.

General Task Description - Continued

Both of our block types (Metal and Plastic) will be running on the same line. However, the holes in the aluminum blocks will need to be punched twice. SCORBOT Robotics Inc. management requires the system to maintain a count in the in the robot's program counter log of the following:

- total number of metal blocks processed
- total number of plastic blocks processed
- total of all failed blocks

This log will be saved to a file and displayed to the screen.

NOTE: When a block is in position to be picked up, the robot shall delay for 5 seconds before retrieving the block. The system shall sound an audible alert from the computer, and the appropriate stack lights must activate when tasks begin, when the robot begins its cycle, when the punch is activated, and when the conveyor is in motion.

The lights must correspond to the operations indicated in the Stack Light Specifications Section in this packet. As they are processed, the blocks are required to be counted within the program to track the total number of blocks processed and the number of blocks that do not have a hole. The blocks with holes will be placed in the appropriate storage area, ready for shipment. The defective blocks will be placed on the conveyor for our recycling program.

SCORBOT Robotics Inc. is requesting that you provide a written document after the demo has been completed that notifies us in writing of any safety issues or improvements that they feel should be addressed.

6.6: Key Specific Task Requirements

- Refer to Stack Light usage Section for all signal requirements.
- Sensors must be implemented to determine if part is in the feeder and when a part is in pick-up position.
- Robot must wait 5 sec after a block is loaded into the feeder shaft before moving.
- Robot must punch plastic blocks once and metal blocks twice.
- Robot will use a sensor to inspect and verify the presence of a hole in block.
- Robot must beep when cycle has started and before punch moves
- Count and log the number of total plastic & metal, and bad blocks (without a hole). Reset the counts to zero if the program execution is stopped.
- Robot will use a sensor to determine type of block (metal or plastic).
- Robot must beep when cycle has started and before punch moves.
- Count and log the number of total and bad blocks (without a hole). Reset the count to zero if the program execution is stopped.
- Each team shall provide SCORBOT Robotics Inc. with a paperwork proposal at a meeting where the proposal must be approved before actual work on the robot system may begin. This paperwork should include schematics, layouts, descriptions, flowchart, overviews, and anything else they feel will show SCORBOT Robotics Inc. that they can complete the task
- Use paper storage area templates for good blocks having holes. Accuracy will be judged.
- Use bad part bins to recycle the bad plastic and metal blocks without holes.
- Wiring will be judged, neatness will count!

6.7: Notes

- You may use the teach pendant to teach, re-teach, jog, or make any other movement of the robot and/or peripheral device.
- There are other related tasks that are to be performed at various different locations, see documentation
- The program shall continue to run waiting for additional blocks to be loaded.
- During evaluation phase the judge(s) will randomly select the order the blocks are to be loaded into the hand loading station. Blocks will always be loaded with their holes facing up.

7: Task Two

7.1: Overview

SCORBOT Robotics Inc. is pleased with what you, our vendors have provided and is looking to upgrade the workcell. We are having quality and throughput issues. SCORBOT Robotics Inc. is looking to add a conveyor for the bad parts for human inspection and efficient storage processes.

Your team's assignment is to assess the requirements of the Task Two specifications and then to develop a proposal on how you plan to accomplish this task. This proposal must include the appropriate documentation for SCORBOT Robotics, Inc. to review in order for your team to gain the judge's approval to build and program the proposed system.

7.2: Evaluation

When your team has completed the design for the workcell layout and the appropriate documentation notify a representative from SCORBOT Robotics, Inc. (judge) to conduct a review of your proposed solution for Task 2.

7.3: Required Documentation

SCORBOT Robotics Inc. is concerned with a few different issues that will arise. SCORBOT Robotics Inc. managers want to see a complete and full proposal of the updated changes that should include all schematics, flow-charts, drawings, layouts, and request a meeting with the vendor before the demo is setup and run. You may update your completed documentation from previous tasks OR request blank copies from the judges.

1. Proposed System layout for the required task
    a. Hardware Layout (Drawing).
    b. Robotic Interface - Input and output connections.
    c. Peripheral hardware connections.
1. Flow chart of proposed robotic program.
2. Any additional supporting documentation as required.

7.4: Initialization:

As in the previously implemented tasks, the blocks will be placed in the "automated parts feeder" in random order the holes facing up. Remember, a judge will be selecting and loading the blocks during a judging run.

7.5: General Task Description

The system to process the blocks using an automated parts feeder shall operate according to all of the requirements of task 1, with the additional requirements listed below.

After the Quality Control process has determined whether a block has passed or failed inspection, all bad plastic and metal blocks will be placed on the non-sensor end of the conveyor. After a bad part is placed on the conveyor, the conveyor will start motion. The Robot may continue motion during this process however, the blue stack light must be flashing while the conveyor is in motion and the conveyor must stop with the use of a sensor for a human inspection of the blocks. The bad part can remain in place until another bad part is placed on the conveyor and will fall into the bad parts bin that will be placed at the end of the conveyor to collect the bad parts as they fall from the end of the conveyor.

Blocks that have passed your quality control process will need to be stacked on a storage pallet and prepared for shipment. The storage pallet can be placed anywhere on your worktable, but accessible for human intervention. Plastic blocks will be placed on the left side of the storage template and the metal blocks will be placed in the right side of the storage template. Stack the parts two blocks tall for visual inspection and packaging. Once all blocks have been stacked, the storage pallet must be moved to the opposite side of the slide base and placed for human pick up.

7.6: Key Specific Task Requirements

- Refer to Stack Light usage Section for all signal requirements.
- Failed blocks are placed on non-sensor end of the conveyor.
- The conveyor photo-electric sensor input is used to stop the conveyor.
- Each team shall provide SCORBOT Robotics Inc. with a paperwork proposal at a meeting where the proposal must be approved before actual work on the robot system may begin. This paperwork should include schematics, layouts, descriptions, flowchart, overviews, and anything else they feel will show SCORBOT Robotics Inc. that they can complete the task
- Use pallet storage area templates for good blocks having holes.
- Plastic blocks are stacked in appropriate locations
- Metal blocks are stacked in appropriate locations
- Full pallet is moved to opposite side of conveyor

7.7: Notes

1. You may use the teach pendant to teach, re-teach, jog, or make any other movement of the robot and/or peripheral devise.
2. There are other related tasks that are to be performed at various different locations, see documentation
3. The program shall continue to run waiting for additional blocks to be loaded.
4. During evaluation phase the judge(s) will randomly select the order the blocks are to be loaded into the automated parts feeder. Blocks will always be loaded with their holes facing up.