ROBOTICS AND AUTOMATION TECHNOLOGY

TEAM GUIDE

intelitek

Contents

ROBOTICS AND AUTOMATION TECHNOLOGY TEAM GUIDE

Intelitek Inc.

Toll Free: 800-221-2763

Phone: 603-413-2600

Fax: 603-437-2137

Email: info@intelitek.com

1. Project Overview

Robotics and automation encompass a substantial part of manufacturing technologies. The integration of these processes within the manufacturing industry has allowed the United States to remain competitive within today's global market.

Installing new, up-to-date manufacturing systems in a timely manner is highly beneficial in remaining competitive in the industrial market. The ability to change an existing system to a more efficient operation saves time in bringing a new product to market and reduces production time, thus lowering production costs.

To maintain industry leadership in this evolving field, it is essential that the labor force remain at the forefront of both current and emerging technologies in design and manufacturing. The goal of this project is to evaluate each student's preparation for employment in the emerging areas of robotics and automation team approach to problem solving in the work environment.

1.1. GUIDELINES

1.1.1. Implementation

Using the description of the process and the provided equipment and materials, you must layout a production system and develop a robot program to fulfill the requirement of the task. Complete documentation of the project is required.

Documentation must include: a sketch of the system layout and equipment placement, a flow chart of the program, a copy of the robot program, wiring connection controller and Input/Output assignments.

This project is broken into four "Tasks"; each requiring program and layout updates. Documentation for each section must also reflect current changes.

1.1.2. Guidelines

The instructor has provided the base outline of the materials within this document to begin your planning and implementation.

Your success on this project is based upon the following criteria:

1. Providing complete documentation of the project.
   - Flow chart.
   - System hardware layout.
   - Controller interface - input and output assignments.
   - Terminal strip assignment.
2. Using the proper terminology for the preparation of the documentation.
3. Packaging the documentation in an orderly and professional manner.
4. Effective use of teamwork in managing the project.

5. Safety in the manufacturing process.
6. Efficient use of time, material and resources.

1.1.3. Equipment Malfunctions

IN THE CASE OF A SOFTWARE OR HARDWARE FAILURE:

The team leader will communicate the problem to the instructor. If it is determined that it is in fact a software or hardware failure, the running time clock may be stopped for that team.

In the case of a stopped time clock, all work will stop for the entire team until the problem is resolved.

1.2. COMPETENCIES

1.2.1. Required Competencies

Successful completion of this project requires the following skills:

1. Perform analysis of task:
    a. Evaluate written task.
    b. Evaluate provided equipment and material.
2. Design, Sketch and Plan:
    a. Determine sequence of operation.
    b. Select equipment and material to meet functional need.
    c. Create Flow Chart.
    d. Create layout.
    e. Create Input and Output Assignment.
    f. Create Terminal Strip Assignment.
    g. Create Wiring Block Diagram.
    h. Process system revision.

1.2.2. Required Competencies - Continued

3. Implement Design:
    a. Develop robot program.
    b. Install equipment.
    c. Integrate equipment with system controller.
    d. Modify system to meet revision requirements.

4. System Performance:
    a. Perform functional test for total system operation.
    b. Present system for evaluation.
    c. Perform functional test to meet revision requirements.
    d. Present revised system for evaluation.

2. Safety

2.1. IMPORTANCE OF SAFETY

To maintain an effective and competitive company, it is in the best interest of both employer and employee to maintain a safe work environment. When a company's history of incidents resulting in injury is minimal, the company increases its likelihood of reduced insurance rates and workman compensation fees.

Safety considerations are taken into account during judging to further replicate a professional industrial environment. Safety glasses with side shields or goggles must be worn at all times. Prescription glasses must be covered by goggles unless equipped with high impact lenses and side shields.

2.2. SAFETY VIOLATIONS

If a team or a team member violates a safety rule, or operates their work cell in an unsafe manner, the following penalties will be enforced:

1st Violation:
Team will be issued a written warning.

2nd Violation
Team will have 50 points deducted from their total score.

3rd Violation
Team will not be allowed to complete the project.

2.3. SAFETY GUIDELINES

Although smaller and slower than an industrial robot, the SCORBOT robot is potentially dangerous. **You must use caution when working with the system to avoid personal injury and damage to the equipment.**

- Do not tamper with wiring, connectors, of any of the devices in the robotic cell that are not specified in the task instructions.
- Safety glasses with side shields or goggles must be worn at all times. Prescription glasses must be covered by goggles unless equipped with high impact lenses and side shields.
- Loose hair must be tied back and clothing must be well fitting when within the work area.
- Never leave a system unattended while it is in operation.
- The robot arm must have ample space to operate freely without encountering physical obstacles.
- Do not enter the robot's work envelope or touch the robot when the system is in operation.

- Do not place your hand or fingers into the gripper.
- Do not overload the robot arm. Workload and gripper may not exceed 2.2 lbs (1 kg).
- Do not leave a loaded arm extended for more than a few minutes.
- Do not physically force the robot arm to move or stop.

2.4. AVOIDING SAFETY HAZARDS

Some safety issues:

1. The Emergency Stop Switch must be depressed when working on your system other than when an active system is essential to accomplish a required part of the task, such as teaching the robot positions.
2. Team members must wear safety glasses when they are in proximity of operational systems or performing tasks that require safety glasses, including cutting and stripping wire.
3. Team members must keep their work area reasonably clean. Clean work places promote efficient and safe working conditions.
4. Team members must keep their teammates and other teams aware of possible dangerous situations, such as flying chips, noise, possible tool breakage, etc.

ⓘ ***Note**: Overall safety is not limited to the above rules. Unsafe acts or practices will not be tolerated and can be grounds for immediate disqualification. Instructor decisions on safety are final.*

3. Quizzes

The following quizzes will verify your competency in the fields of electrical, pneumatics, robotics, and sensors in robotic automation technology. (Quizzes have been omitted from this document.)

4. Scenario Overview

Your company, Robotics and Automation Inc., has assigned you and your teammate to compete for a lucrative contract designing new production lines for XYZ Corporation.

The engineering department has provided you with a description of the required process and a list of equipment and material available for use in system design and implementation. Your assigned team number will be you team name.

Quality and production costs are essential in remaining competitive in the manufacturing industry. Therefore, project completeness, elapsed time off-line, cycle time, and implementation techniques will all be considered as part of your evaluation.

4.1. TEAM GUIDELINES

4.1.1. Team Work

With today's complex manufacturing challenges, no individual is equipped with all the answers. Success in robotics and automation is often found using a team approach. Manufacturers combine the resources and abilities of a team to resolve problems.

In the interest of emulating industry, this project will be structured in this manner. Teams of two will demonstrate their ability to perform, exhibit, and compile the skills and knowledge necessary to be successful in the field of robotics and automation technologies.

Teams MUST be composed of two members, one specialist in each of the following fields:

- Robot Programming
- Electro-mechanical Integration

4.1.2. Team Dynamics

This project parallels industry; with group members interacting at will. The robot programmer will program the robot and peripheral equipment. The Electro-mechanical integrator will install the peripheral equipment and integrate it into the system.

Teams should divide duties between the team members. When a team member has spare time, they will help their teammate. All Team members are responsible for double-checking each other’s work and quality control.

4.1.3. Suggested Department Contributions

Robot programmer:

Robot program

Program flow chart

Hard copy of program

Electro-mechanical integration tech:

Equipment placement

Electrical integration

System layout sketch

Both team members:

Task analysis

System layout

Documentation

4.1.4. Team Guidelines

Your team should follow these guidelines:

1. Primary responsibilities and duties are organized.
2. A team leader is identified to interact with instructor.
3. Breaks are to be taken within assigned individual work areas.
4. Only one team member is allowed to leave the work area at a time.
5. You must save your final programs. This disk is a part of your project documentation.
6. You will be notified of your final completion time. Only a team that has had a stopped clock, as previously referenced, will allowed additional time.

4.2. EQUIPMENT & MATERIALS

4.2.1. Workcell Components

The following components are included in your workcell:

1. Computer and printer.
2. SCORBOT ER-4u robot, controller, controller interface, and cables.
3. Teach pendent.
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).

4.2.2. Workcell Components - Continued

10. Storage area and bad parts bin.
11. Sensor station with proximity switch and micro switch.
12. AC power and air supply.
13. Emergency stop switch.
14. Power terminal strip.
15. Power strip and extension cord.
16. E-Stop switch.
17. Mounting platform.
18. Plastic and metal blocks.

4.2.3. Required Materials

1. Notebooks and pencils.
2. Documentation.
3. Flow Chart Template.
4. Standard Safety glasses, clear lens only, for each constant.
   - Colorized Lenses are not accepted.
   - Sun Glasses are not accepted.

4.2.4. Required Handtools

1. Wire cutters/diagonals 3” to 6t.
2. Wire strippers.
3. Long nose/needle nose pliers 3” to 6”.
4. Screwdrivers (3” to 6” blade length).
   - Common Set to include 1/8”, 1/4” & 3/8”.
   - Phillips Set to include #0, #1 & #2.
5. 6” to 12” ruler.
6. Hookup wire is required, 20 – 24 AWG.
   - 5 different wire colors.
   - Recommend 150’ of each color.

4.2.5. Optional Materials

1. User manuals including:
   - SCORBOT ER-4U
   - Controller USB
   - SCORBASE
   - Teach Pendant
2. Power screwdriver (with cross point and common bits) to mount components to platform.
3. Watch with second hand, digital counter, or stopwatch.
4. Allen wrenches, Set to include 5mm, 3mm and 7/64”.
5. Multi-meter with leads.
6. Tie Wraps.

4.3. ADDITIONAL INFORMATION

4.3.1. The Client

XYZ Corporation has been providing high quality affordable widgets for commercial and consumer use since 1887. As our business grew, so did our need to become more efficient and cost-effective in our manufacturing facilities. We see a future in the automation of our production process.

4.3.2. The Vendor

Our vendor has supplied a ER4u robot mounted on a Linear Slide Base in the center of work platform. This provides a work envelope on either side of the slide base. The controller has been placed on the platform with Controller Interface.

The Emergency Stop switch and Stack Lights are attached to the rear corner while the Teach Pendent 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.

4.3.3. Special Criteria

Before any robot motion, safety warnings must be given. The Stack Lights will be used to give these warnings. 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 5.1 Stack Light Usage.

When parts without holes are gently placed in the bad parts bin, this event must be signaled with lights. Bad parts must also be counted. The count of bad parts must be displayed with the PrintToScreenLog command. See 5.7 Print to Screen.

When parts with holes (good parts) are placed on the Storage Area overlay of this event must be signaled. See 5.1 Stack Light Usage.

4.3.4. Team Goals

Teams are provided with a written description of task requirements and available equipment and material. Your team will develop a system layout and robot program then demonstrate your product.

Upon completion of each task you will be required to refine your system design and again demonstrate its functionality.

4.3.5. Project Objectives

1. To have every team complete this project.
2. To have each team member demonstrate reading and writing skills.
3. To have each team member use their critical thinking and problem solving abilities.
4. To have each team member illustrate responsibility, teamwork, self-management skills, and professionalism.

4.3.6. Evaluation

- Have all parts available for the instructor to select loading order.
- Wait for the instructor to arbitrarily select the order parts are to be loaded into the parts feeder.
- The instructor will instruct you when to load the parts.
- When instructed by the instructor you will run the program again.

5. Documentation, Setup & Usage

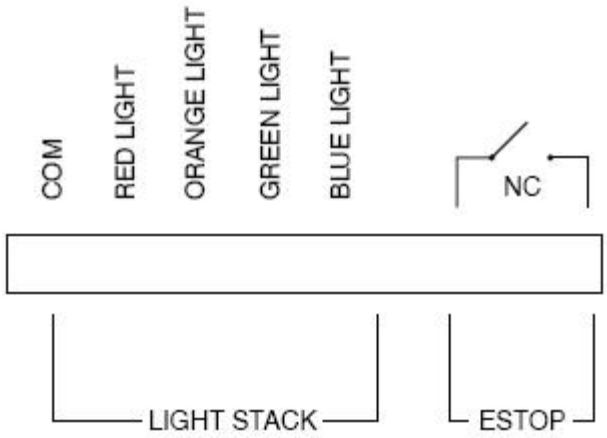
The following sections contain documentation, setup and usage information:

- 5.1 Stack Light Usage
- 5.2 Power Supply
- 5.3 Sensor Box
- 5.4 Photo Sensor
- 5.5 Parts Feeder & Press w / Sensors
- 5.6 Flow Chart
- 5.7 Print to Screen
- 5.8 Conveyor Control
- 5.9 Documentation

5.1. STACK LIGHT USAGE

5.1.1. Stack Light Specifications

DO NOT DISASSEMBLE THE STACK LIGHT UNIT



Stack Light requires 12 volts DC. Each color indicates the following:

Color	State	Usage
Red	ON	when the robot program is running and workspace is unsafe.
Yellow	ON	during pressing operation.
Green	ON	when power for all motors is OFF and the work area is safe for technicians to work in.
	FLASHING	when part is ready to load during Task 1 & 2.
Blue	ON	for two seconds when a “bad part” is identified.

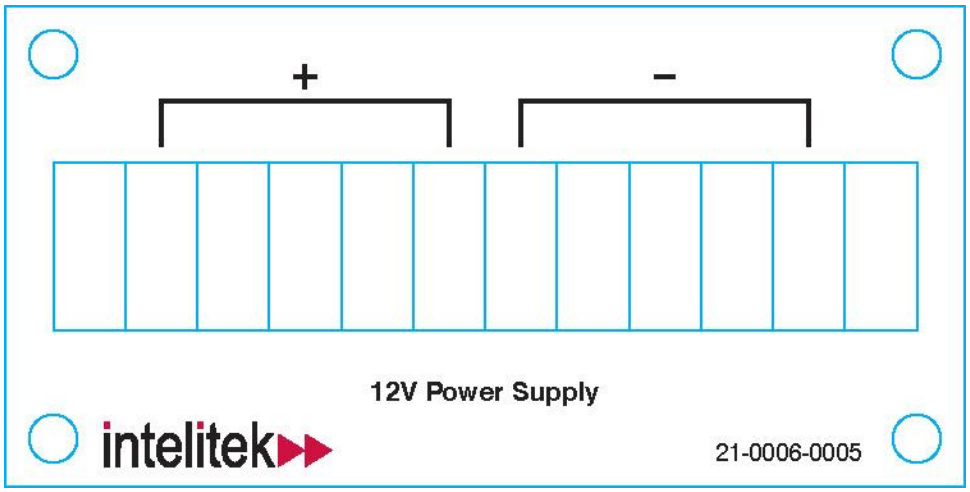
DO NOT DISASSEMBLE THE STACK LIGHT UNIT

If you have Questions, ASK the instructor.

5.2. POWER SUPPLY

5.2.1. The 12 Volt DC Power Supply

+12 Volts DC with common ground is used to power all devices in the work cell. The power supply is connected a terminal strip that can be located anywhere on the table. Your team may wire to any available terminal.



ⓘ ***Notes****: This unit (12 V Power Supply) and the Controller each have their own power supplies.Since there are multiple power supplies, one powering the device that produces a signal and the other apart of the device that accepts a signal, they must have a common ground; a common reference between all power supplies.*

5.3. SENSOR BOX

5.3.1. Wiring

The Sensor Box contains an Inductive Proximity Sensor and Micro-switch plus a Terminal Strip.

DO NOT OPEN SENSOR BOX

The Sensor Box contains an Inductive Proximity Sensor and Micro-switch

Terminal strip

Inductive Proximity (Prox) Sensor:

+ 12 Volts DC (Power for the Inductive Proximity Sensor)

- Ground (Common)

SIG Output Signal

Limit Switch:

NO Normally Open Contact

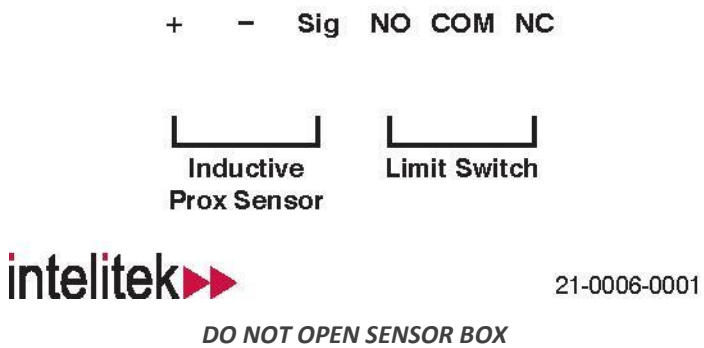
COM Common

NC Normally Closed Contact

DO NOT OPEN SENSOR BOX

If you have Questions, please ASK the instructor.

Sensor Box



DO NOT OPEN SENSOR BOX

5.4. PHOTO SENSOR

5.4.1. Conveyor Sensor

1. Connect attached power supply to a 115 volt AC source after connections have been made.
2. Connect the remaining leads to an Input and Ground on the I/O Interface. The leads are polarity sensitive.
3. Verify the sensor is working by running the system and placing your hand in front of the sensor.

5.5. PARTS FEEDER & PRESS W / SENSORS

5.5.1. Pneumatic Parts Feeder - Components

The parts feeder is an assembled device that consists of:

- Adjustable air regulator.
- Double Acting cylinder with flow control valves.
- Feeder Solenoid.
- Feeder Limit Switch (Part-in-Stack detection sensor).
- Part Present Limit Switch.
- Tubing.
- Fittings.

5.5.2. Pneumatic Parts Feeder - Theory of Operation

Air from the Feeder Solenoid Valve via the adjustable regulator is applied to the valve that is connected to the long cylinder.

When 12 volts DC is applied to the “Feeder Solenoid” the valve is actuated causing the double acting cylinder to extend.

The flow control valve controls the rate of extension. The removal of the 12-volt from the Feeder Solenoid valve allows the double acting cylinder to retract. The flow control valve controls the rate of retraction.

5.5.3. Pneumatic Parts Feeder - Theory of Operation - Continued

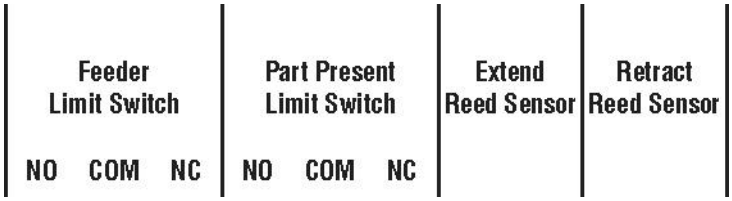
The “Feeder Limit Switch” senses if a part is present in the feeder stack.

The "Part Present Limit Switch” is for detecting if a part is present and available for the Robot to pickup.

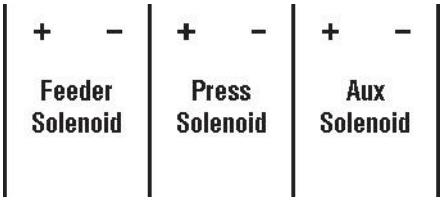
NO Normally Open

NC Normally Closed

Feeder Terminal Strip



Solenoid Terminal Strip



To activate the feeder and press solenoid, apply 12V DC to the solenoid terminal strips through the controller.

5.5.4. Pneumatic Press with Sensors - Components

The press consists of:

- Double acting pneumatic cylinder.
- Press Solenoid Valve.
- Tubing.
- Fittings.

Reed Sensors provide a contact closure.

5.5.5. Pneumatic Press with Sensors - Theory of Operation

Air from the Press Solenoid Valve via the adjustable regulator is applied to the valve that is connected to the long cylinder. When 12 volts DC is applied to the “Press Solenoid”, the valve is actuated causing the double acting cylinder to extend.

The flow control valve controls the rate of extension. In the removal of the 12-volts from the Press Solenoid, the valve allows the double acting cylinder to retract. The flow control valve controls the rate of retraction.

5.5.6. Pneumatic Press with Sensors - Theory of Operation - Continued

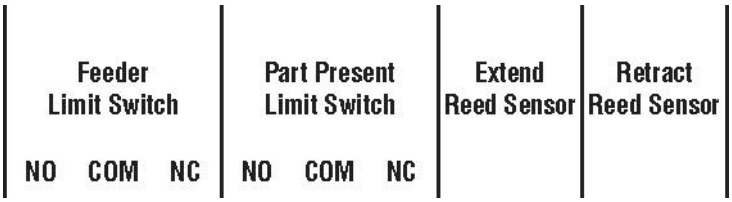
A Reed Sensor determines if the cylinder is extended or retracted. The Reed Sensor is a magnetic switch that closes when an internal portion of the cylinder is in close proximity to the switch.

The flow control valves control the rate of extension and/or retraction of the cylinder.

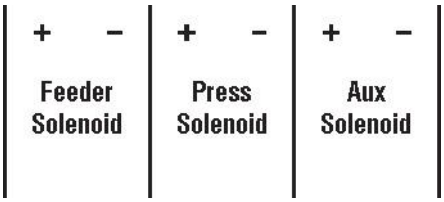
NO Normally Open

NC Normally Closed

Feeder Terminal Strip



Solenoid Terminal Strip



5.6. FLOW CHART

5.6.1. Acceptable Symbols

Quite often, when employed by a Company or a Corporation, anything that you produce belongs to them. The corporation owns the patents and copyrights. Therefore, complete documentation is quite essential.

You may think that keeping the knowledge to yourself is job security but at some time in your career you could be the recipient of an undocumented system. In this situation you will want all the documentation you can find. Document your work completely.

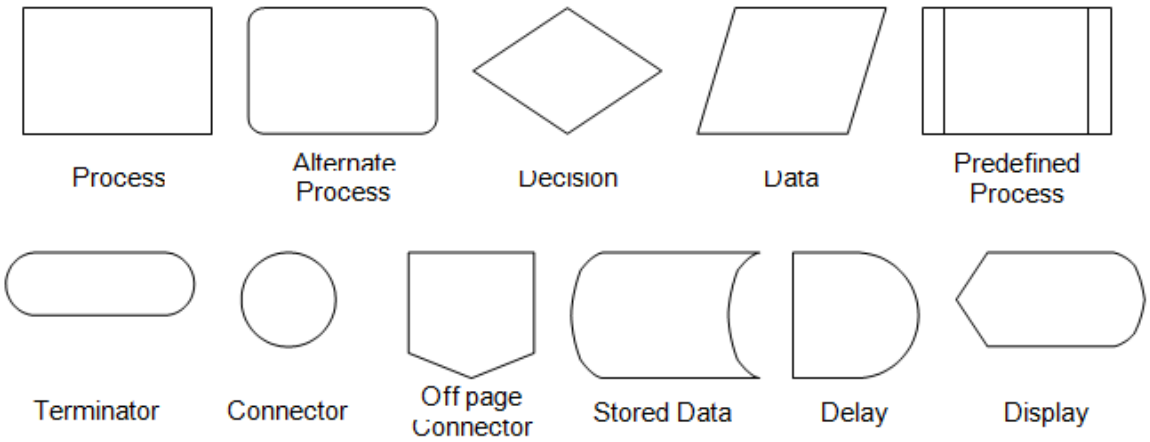
5.6.2. Acceptable Symbols - Continued

1. The Flow Chart symbols you use must be the symbols provided on this page.
   - The program must start with a Terminator symbol and then proceed through the assorted symbols that best explain your program.
   - Use arrow heads to indicate the direction of program flow.
   - Continuations without lines must use Connectors with identifying characters (i.e: A, b, 1 or 2, etc.).
   - Use these symbols to develop your Flow Chart.

5.6.3. Acceptable Symbols - Continued

2. The symbols are representative of the required shapes. You may change the size to meet your needs.
3. Use a straight edge to draw the symbols. Paper is available in the back cover of your notebook.
4. Be neat. If the instructor can't read them they can't score them. This will result in points lost.
5. Your Flow Chart and Robot Program must coincide. The Flow Chart/Robot Program scoring will be based on how well you designed your Flow Chart before you started developing your Robot Program.

FLOW CHART SYMBOLS



5.7. PRINT TO SCREEN

5.7.1. Commands

The first line in your robot program MUST be a PrintToScreenLog command. Another PrintToScreenLog command must appear when your program reaches the point where it is looking for the next part and all of the previous parts have been processed.

This will help in determining your run time! There may be other instances when the task requires the use of the PrintToScreenLog commands.

5.7.2. Commands - Continued

The following is a sample program to TEST the PrintToScreenLog command:

```
1. Counting parts called: ITEM
2. Using a Variable named: NUMBER
3. Set Variable NUMBER = 0
4. LOOP:
5. Set Variable NUMBER = NUMBER + 1
6. Print to Screen & Log: ITEM= 'NUMBER'
7. Wait 25 (10ths of seconds)
8. If NUMBER<3 Jump to LOOP
```

***Note**: If using subroutines, they must be at the end of the program. Any remarks must be within the subroutines.*

5.8. CONVEYOR CONTROL

5.8.1. Sample ER-4U SCORBASE Software program

In order for the conveyor to stop correctly, please use the following commands in your program:

```
Start Conveyor Axis 8 at Speed 5 in Plus Direction
Enable Input Interrupt 6
On Input Interrupt 6 On Call Subroutine STOP_CONVEYOR Wait 100 (10ths of seconds)
.
.
Set Subroutine STOP_CONVEYOR Stop Conveyor Axis 8
Return from Subroutine
```

5.8.2. Program and Subroutines

In this example:

- Positions 12 and 13 – Parts are above the conveyor.
- Positions 2 and 3 – Parts are on the conveyor.
- Photo Sensor is connected to input 6.

***Note**: When using subroutines, they must be at the end of the program. Any remarks must be within the subroutines.*

5.8.3. Program and Subroutines - Continued

Program example:

```
Remark: **** Place part on Conveyor **** Go to Position 12 Speed 5
Go to Position 2 Speed 5
Open Gripper
```

```
Go to Position 12 Speed 5
Start Conveyor Axis 8 at Speed 5 in Plus Direction
Enable Input Interrupt 6
On Input Interrupt 6 On Call Subroutine STOP_CONVEYOR Wait 100 (10ths of seconds)
.
. The rest of the main program
.
.
Remark: ***Subroutine's start here*** Set Subroutine STOP_CONVEYOR Stop Conveyor Axis 8
Go to Position 13 Speed 5 Position 13 – part is above the conveyor
Go Linear to Position 3 Speed 5 Position 3 – part is above the conveyor
Close Gripper
Go Linear to Position 13 Speed 5
Return from Subroutine
```

5.9. DOCUMENTATION

5.9.1. Forms

The following documentation must be prepared by teams for judging. These sheets are available for download as one inclusive document by clicking here OR individually below:

- Flow Chart
- System Hardware Layout
- Controller Interface - Input Assignments Controller Interface - Output Assignments Terminal Strip Assignments
- Safety Issues

5.9.2. Printer Friendly Version

For a copy of this module in PDF format please click here. This document also includes all documentation previously referred to in 5 Documentation, Setup & Usage.

Forms are located from page 29 of this printed text.

6. Task One

6.1. OVERVIEW

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

Your team is to assess the task at hand, then develop a proposal on how you plan to accomplish this task. This proposal must include the appropriate documentation for XYZ Corporation to review in order to gain approval to accomplish this task.

6.2. EVALUATION

When your team has completed the design for the workcell layout and appropriate documentation, notify a representative from XYZ Corporation (instructor) to schedule a review of your proposed solution.

6.3. REQUIRED DOCUMENTATION

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

6.4. INITIALIZATION

The parts will be placed in the “hand loading station” when the appropriate light signals the operator that the work area is safe.

The robot should wait for a specified amount of time after the part is in place. Use an assortment of all available blocks. **The blocks will be placed with the holes up.**

6.5. ASSIGNMENT

XYZ Corporation wants to automate a “hole” punch operation and quality inspection for our model A widget. This will require a robot to pick up a widget from a hand-loading station, punch a hole in it, inspect the hole and pass or fail the widget.

A switch will recognize when a part is ready to be picked up and the robot will delay for 5 seconds before taking another blank part. An audible alert must sound, and the appropriate lights must activate when tasks begin, when the robot begins its cycle, and when the punch is activated.

The lamps should correspond to the operations as indicated in Stack Light Usage in this packet. The parts should all be counted within the program. Management needs to know total parts and failed parts.

The passing parts will be placed in the appropriate storage area, ready for shipment. The failed parts will be placed in and sorted into two bins. XYZ is requesting that you provide a written document after the demo has been completed that notifies us of any safety issues or improvements that they feel should be addressed.

6.6. KEY POINTS

- Refer to 5.1 Stack Light Usage.
- Robot will use a sensor to determine when widget is in place.
- Robot must wait 5 sec after widget is loaded before moving.
- Robot will use sensor to inspect and verify hole in widget.
- Robot must beep when cycle has started and before punch moves.
- Log counts total and failed count resets if program is stopped.
- Teams must provide management with written documentation and presentation for approval before hardware is provided for demo. This paperwork should include schematics, layouts, descriptions, flowchart, overviews, and anything else they feel will show management that they can complete the task.
- Use paper storage area templates for good parts.
- Use bad part bin for failed parts.

6.7. NOTES

1. You may use the teach pendant to teach, re-teach, jog, or any other movement of the robot and/or peripheral devise.
2. There are other related tasks that are to be performed at other locations, see 5.9 Documentation5.9.
3. The program shall continue to run while waiting for additional parts to be loaded.
4. During evaluation phase, the instructor will randomly select the order in which the parts are loaded into the parts feeder. Parts will always be loaded with their holes facing up.
5. Save your robot program often and after each revision. It is recommended that you save changes individually, adding a consecutive revision number to your file name each time. This will allow your team to return to previous versions in the event that you experience difficulties with you current robot program.

7. Task Two

7.1. OVERVIEW

XYZ Corporation has found a tremendous amount of success with what you, our vendor, have implemented in our manufacturing facility. We have reduced cost dramatically along with an increase in quantity and quality over the past year.

One of the major reasons that we upgraded to a robotic system is because of the flexibility of the system and now we are looking to implement a new product line.

7.2. EVALUATION

When your team has completed the design for the workcell layout and appropriate documentation, notify a representative from XYZ Corporation (instructor) to schedule a review of your proposed solution for Task 2.

7.3. REQUIRED DOCUMENTATION

You may update your completed documentation from Task One OR request blank copies from the instructor.

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

7.4. INITIALIZATION

The parts will be placed in the “hand loading station” when the appropriate light signals the operator that the work area is safe.

The robot should wait for a specified amount of time after the part is in place. Use an assortment of all available blocks. <b>The blocks will be placed with the holes up.

7.5. ASSIGNMENT

We here at XYZ see our future in flexible manufacturing and would like you to provide an upgraded proposal and demonstration of your solution.

Our newest and latest product is an all-metal version of our widget. Both our widgets will be running on the same line and the aluminum widget will need to be punched twice. XYZ's management will need to see a count of total metal, total plastic, failed metal, and failed plastic widgets in a log.

We are concerned with a few different issues that may arise. Our managers want to see a complete and full proposal of the updated changes including all schematics, flow-charts, drawings, layouts, and request a meeting with your team before the demo is setup and run.

XYZ is requesting that your team provide a written document, after the demo has been completed, that notifies us of any safety issues that may need to be addressed.

7.6. KEY POINTS

- Refer to 5.1 Stack Light Usage.
- Robot will use sensor to determine when widget is in place.
- Robot must wait 5 sec after widget is loaded before moving.
- Robot will use sensor to inspect and verify the hole in the widget.
- Robot must beep when cycle has started and before punch moves.
- Log counts total and failed count resets if program is stopped.
- Punch will press plastic widgets once and metal widgets twice.
- Your team must provide management with an upgraded written proposal that will need to be approved before hardware is provided for demo. This paperwork should include updates to existing schematics, layouts, descriptions, flowchart, overviews, and anything else you feel will show management that you can complete the task.

7.7. NOTES

1. You may use the teach pendant to teach, re-teach, jog, or any other movement of the robot and/or peripheral devise.
2. There are other related tasks that are to be performed at other locations, see 5.9 Documentation.
3. The program shall continue to run while waiting for additional parts to be loaded.
4. During evaluation phase, the instructor will randomly select the order in which the parts are loaded into the parts feeder. Parts will always be loaded with their holes facing up.

8. Task Three

8.1. OVERVIEW

XYZ Corporation has grown leaps and bounds since adding an additional product and implementing the flexible manufacturing system. However, XYZ has had some safety issues with employees getting hurt on the job loading parts.

Management has mandated an immediate system upgrade to the use of a parts feeder to keep employees' hands away from the robot. The feeder is equipped with safety switches in case the feeder is empty.

8.2. EVALUATION

When your team has completed the design for the workcell layout and appropriate documentation, notify a representative from XYZ Corporation (instructor) to schedule a review of your proposed solution for Task 3.

8.3. REQUIRED DOCUMENTATION

You may update your completed documentation from Task Two OR request blank copies from the instructor.

1. Updated System layout.
    a. Hardware Layout (Drawing).
    b. Robotic Interface – Input and output connections.
2. Peripheral hardware connections.
3. Flow chart of proposed robotic program.
4. Any additional supporting documentation as required.

8.4. INITIALIZATION

The parts will be placed in the "parts feeder" with the blocks placed in random order and the holes facing up.

8.5. ASSIGNMENT

XYZ has a problem with the flexible manufacturing system and would like you to provide an upgraded proposal and demonstration of your solution.

We are concerned with a few different issues that may arise. Our managers want to see a complete and full proposal of the updated changes including all schematics, flow-charts, drawings, layouts, and request a meeting with your team before the demo is setup and run.

XYZ is requesting that your team provide a written document, after the demo has been completed, that notifies us of any safety issues that may need to be addressed.

8.6. KEY POINTS

- Refer to 5.1 Stack Light Usage
- Feeder's sensors must be implemented to determine part in place and whether feeder is empty
- Cycle must wait 5 sec after widgets are loaded in feeder before moving only when feeder is empty
- Robot will use sensor to inspect and verify the hole in the widget.
- Robot must beep when cycle has started and before punch moves.
- Log counts total and failed count resets if program is stopped.
- Punch will press plastic widgets once and metal widgets twice.
- Your team must provide management with an upgraded written proposal that will need to be approved before hardware is provided for demo. This paperwork should include updates to existing schematics, layouts, descriptions, flowchart, overviews, and anything else you feel will show management that you can complete the task.

8.7. NOTES

1. You may use the teach pendant to teach, re-teach, jog, or any other movement of the robot and/or peripheral devise.
2. There are other related tasks that are to be performed at other locations, see 5.9 Documentation.
3. The program shall continue to run while waiting for additional parts to be loaded.
4. During evaluation phase, the instructor will randomly select the order in which the parts are loaded into the parts feeder. Parts will always be loaded with their holes facing up.

9. Task Four

9.1. OVERVIEW

XYZ Corporation is pleased with what your team has provided and is looking to upgrade once again. We are having quality and throughput issues. Our company is looking to add a conveyor system to remove only good widgets, both metal and plastic.

This system will stop, with the use of a sensor, for human inspection. The widgets will stop on the conveyor for

5 seconds and the robot will beep when stopping and before restarting the conveyor. This stop is where a human operator will remove the widget, visually inspect it, and place it on the appropriate template.

9.2. EVALUATION

When your team has completed the design for the workcell layout and appropriate documentation, notify a representative from XYZ Corporation (instructor) to schedule a review of your proposed solution for Task 4.

9.3. REQUIRED DOCUMENTATION

You may update your completed documentation from Task Three OR request blank copies from the instructor.

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

9.4. ASSIGNMENT

XYZ has a problem with our flexible manufacturing system and would like you to provide an upgraded proposal and demonstration of your solution.

We are concerned with a few different issues that may arise. Our managers want to see a complete and full proposal of the updated changes including all schematics, flow-charts, drawings, layouts, and request a meeting with your team before the demo is setup and run.

XYZ is requesting that your team provide a written document, after the demo has been completed, that notifies us of any safety issues that may need to be addressed.

9.5. KEY POINTS

- Refer to 5.1 Stack Light Usage.
- Feeder's sensors must be implemented to determine part in place and whether feeder is empty.
- Conveyor's sensor will be used to stop part for 5 seconds on conveyor for human visual inspection.
- Cycle must wait 5 sec after widgets are loaded in feeder before moving only when feeder is empty.
- Robot will use sensor to inspect and verify the hole in the widget.

9.6. KEY POINTS - CONTINUED

- Robot must beep when cycle has started, before punch moves, when conveyor stops, and when conveyor starts.
- Log counts total and failed count resets if program is stopped.
- Punch will press plastic widgets once and metal widgets twice.
- Your team must provide management with an upgraded written proposal that will need to be approved before hardware is provided for demo. This paperwork should include updates to existing schematics, layouts, descriptions, flowchart, overviews, and anything else you feel will show management that you can complete the task.

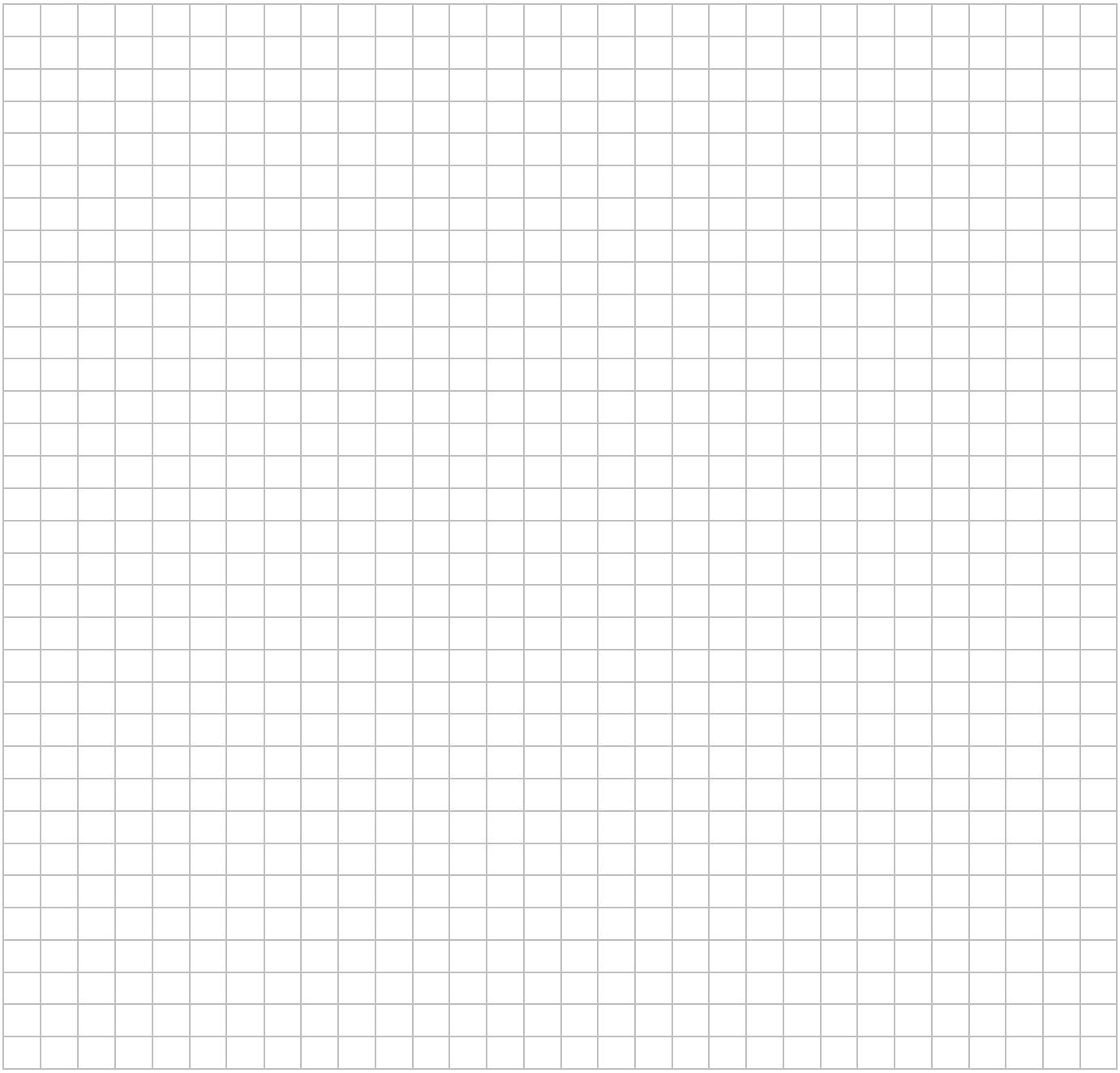
9.7. NOTES

1. You may use the teach pendant to teach, re-teach, jog, or any other movement of the robot and/or peripheral devise.
2. There are other related tasks that are to be performed at other locations, see 5.9 Documentation.
3. The program shall continue to run while waiting for additional parts to be loaded.
4. During evaluation phase, the instructor will randomly select the order in which the parts are loaded into the parts feeder. Parts will always be loaded with their holes facing up.

Flow Chart

Draw a flowchart of the Robot program. Use a straight edge. Be complete, neat and legible.

.....Total Points _____



See instructor or instructor for additional copies.

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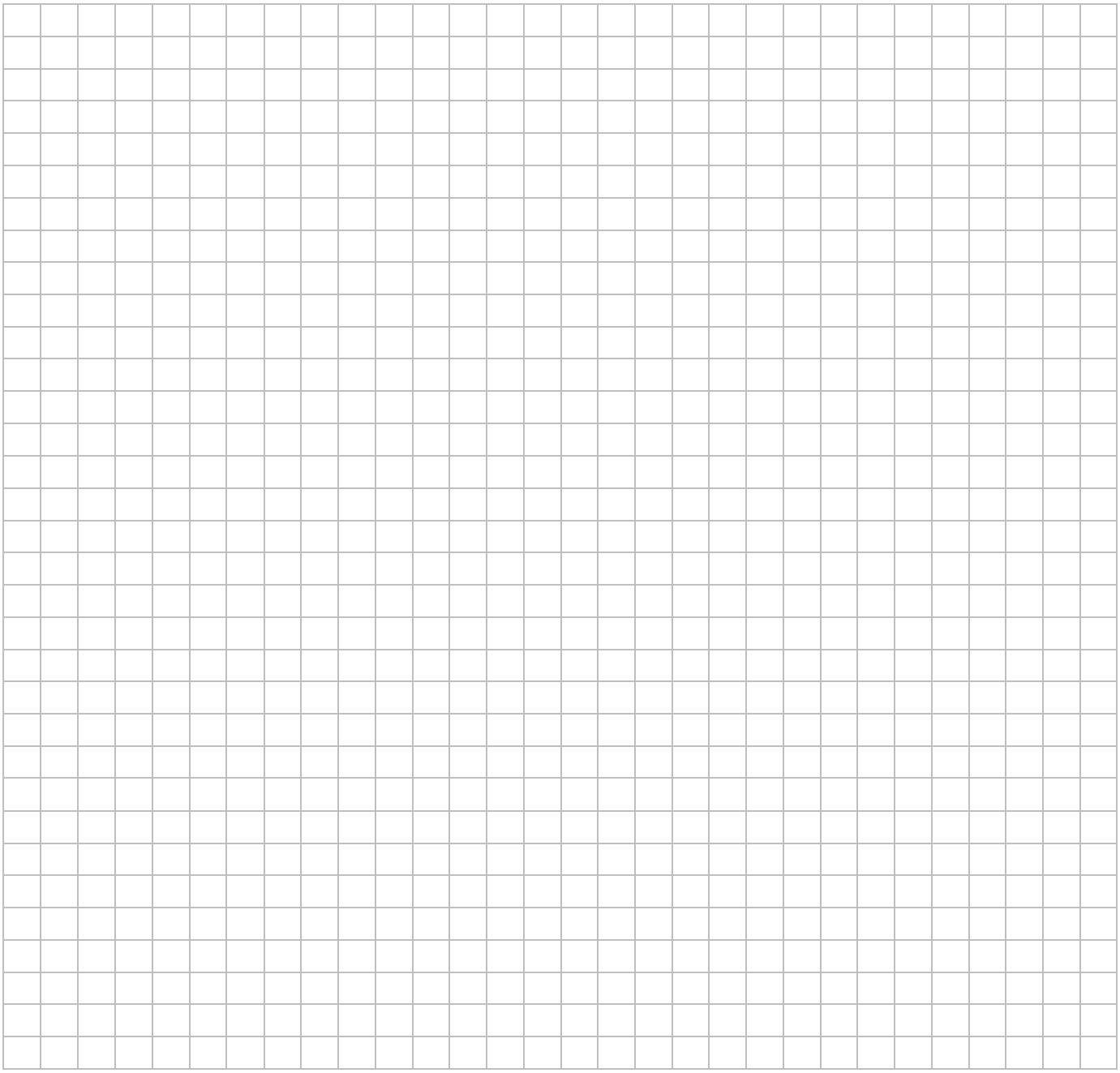
System Hardware Layout

Draw a sketch of the hardware layout of your system. Use a straight edge. Be complete, neat and legible.

.....Total Points _____



Controller Interface - Input Assignments

Describe what is connected to each input on the controller interface. The instructor must be able to read and understand what is connected to each input of the controller interface.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Notes:

Controller Interface - Output Assignments

Describe what is connected to each output on the controller interface. The instructor must be able to read and understand what is connected to each output of the controller interface. They should also be able to look at the device and see the wire color etc.

Output #1 COM _____	NO _____ NC _____
Output #2 COM _____	NO _____ NC _____
Output #3 COM _____	NO _____ NC _____
Output #4 COM _____	NO _____ NC _____
Output #5 COM _____	NO _____ NC _____
Output #6 COM _____	NO _____ NC _____
Output #7 COM _____	NO _____ NC _____
Output #8 COM _____	NO _____ NC _____

Terminal Strip Assignments

Describe what is connected to each device. The instructor must be able to read and understand how each device is connected.

Pneumatic Parts Feeder Pneumatic Press

Feeder Terminal Strip

Feeder Limit Switch

NO _____

COM _____

NC _____

Part Present Limit Switch

NO _____

COM _____

NC _____

Extended Reed Sensor

Top _____

Bottom _____

Retracted Reed Sensor

Top _____

Bottom _____

Solenoid Terminal Strip

Feeder Solenoid

\+ _____

\- _____

Press Solenoid

\+ _____

\- _____

Aux Solenoid

+	Not Used	
-	Not Used	

Terminal Strip Assignments - Continued

Describe what is connected to each device. The instructor must be able to read and understand what is connected to each device.

Stack Light

COM _____

Red _____

Yellow _____

Green _____

Blue _____

Sensor Box - Inductive Prox Sensor

\+ _____

\- _____

Sig _____

Limit Switch

\+ _____

\- _____

Sig _____

Safety Issues

Describe any safety issues that are of concern when running the widget process.