Visual Control System: Manufacturing Quality Control

Quincy Sprockets, Inc. has been a successful producer of sprockets for nearly 40 years. Priding itself very highly in the quality of the final product, the company has always stationed its most trusted employee at the end of the assembly line to inspect each sprocket for quality, including the size, color, and alignment of the company logo. After years of ensuring that each sprocket meets the strict company standards, this employee is set to retire. Looking to move into the 21st Century, the CEO has decided that now is the time to replace this human inspection with a computer-controlled system that can do the job faster and more reliably.

Challenge

Your challenge is to design a fully-automated control system to inspect each sprocket before it leaves the assembly line. If the logo on the sprocket meets the desired quality standards, your system should "accept" it and allow it to continue on for shipping, but if it does not, your system should "reject" it by directing it off the conveyor belt and into a bin. Your system should accurately sort 25 sprockets as quickly as possible.

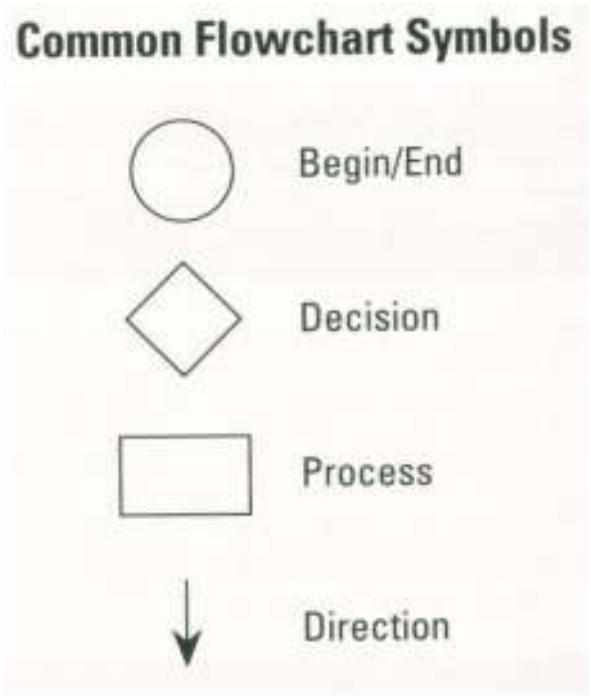
Materials: To accomplish this task, you will use the following:

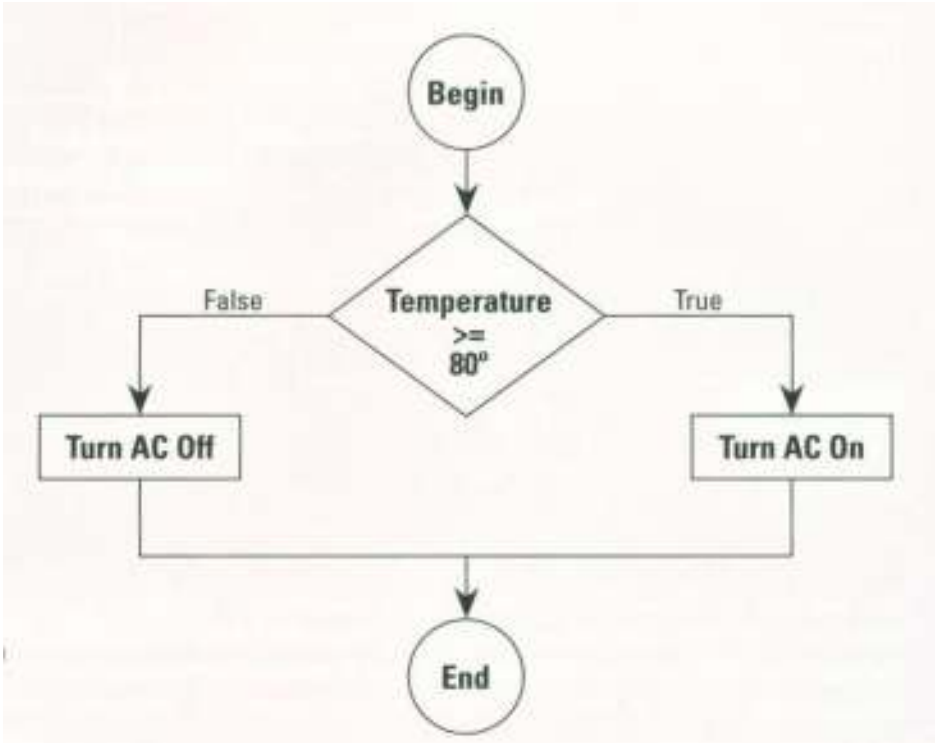
- A webcam
- A conveyor belt
- A DC motor to drive the conveyor belt
- A set of pneumatics devices, including a compressor, air holding tanks, pistons, and valves that can be switched (open/closed) using 12 volts
- Software that can analyze an image for color, shape, etc., compare it to an ideal logo, and command a hardware box to produce voltages when desired

Flow Chart:

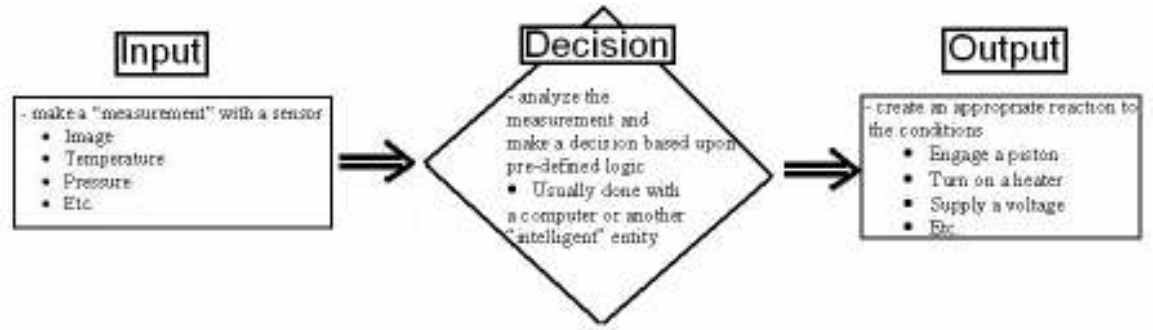
Often one of the first steps an engineer takes in designing a process is to draw a *flow chart* to help gather his/her thoughts and to visualize the steps necessary to accomplish the objective.

The next page lists the basic symbols used in drawing a flow chart. It also shows an example of a flow chart used to run automated air conditioning, a very common example of a control system. Notice that the decision box involves a simple question whose answer determines the action the process takes next. Is the temperature greater than or equal to 80º? If the answer is yes, the air conditioning turns on. If the answer is no, the air conditioning turns off. Similarly, your process will involve simple logical steps that determine the sequence of actions to take place. It is important to keep in mind that a computer is not really that intelligent; it does only what it is instructed to do. At each step, the computer must be given very specific instructions.


Common Flowchart Symbols
Begin/End
Decision
Process
Direction

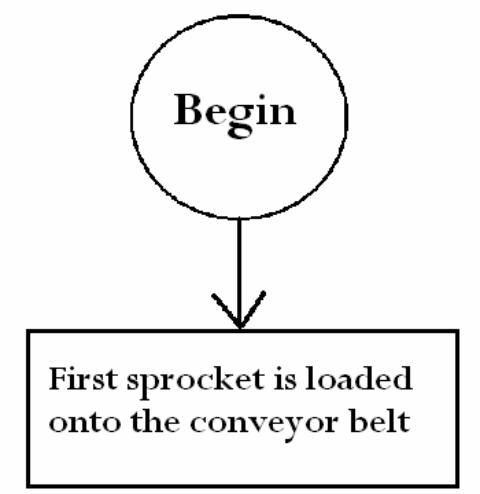

Begin
Temperature
>=
80°
False
True
Turn AC Off
Turn AC On
End

For any *control system*, the following flowchart represents the general sequence of events that takes place:



Begin to think about your solution by sketching a flow chart for how you might approach this specific problem. The first step is shown on the next page. Try to be as detailed as possible, but realize that your process will likely evolve a great deal between now and challenge day.

With the software you will have the ability to control the conveyor belt motor and the pneumatics (<u>when, why, and for how long</u> each of these devices turns on/off). You will eventually be provided with a quality criteria (what the company deems acceptable for its logo and what it does not), and your system must deal with both acceptable sprockets and rejects. Show what should happen with each possibility in this flow chart.


Begin
First sprocket is loaded onto the conveyor belt