LAB 12
SIMULATING A WASHER CYCLE

Figure 5: Washing machine schematic

PROBLEM STATEMENT:

The washing time of the washer comprises three cycles: wash, rinse, and spin cycles. During the wash cycle, water is added until a high level switch is triggered on. Then, the water valve is shut off and the agitator is activated for 12 minutes. After the 12 minutes timer has expired, the dirty water is drained out through a pump that is activated as soon as the agitator stops. The drain pump is stopped when the low-level switch is triggered low. Then, the rinse cycle starts.

The rinse cycle starts when the low-level switch is triggered low (end of wash cycle). The cycle starts by adding water into the tub until the high level switch is triggered. As soon as the high level switch is triggered, the water valve is shut off and the agitator is activated for 6 minutes. When the 6-minute clock has expired, the agitator is stopped and the water is drained out. The pump continues to drain the water until the low-level switch is triggered low, then the spin cycle starts.

During the spin cycle, the motor connected to the agitator disengages from the gearbox permitting the agitator to spin freely for 4 minutes. To simplify the problem use two separate motors to simulate the spin and agitate cycles as indicated below.

SIMPLIFIED PROGRAM – (use seconds instead of minutes to speed up simulation).

Step 1: Press the start button
Step 2: Add water until the high level switch is triggered.
Step 3: Shut off the water valve.
Step 4: Turn the agitator on for 12 seconds.
Step 5: Stop the agitator and start the pump until the low level switch is triggered off.

**RINSE CYCLE**
Step 6: Repeat steps 2 through 5 (the rinse time for step 4 is 6 seconds).

**SPIN CYCLE**
Step 7: Turn the spin motor on for 4 seconds.

**PRELAB # 12**

Create a ladder logic diagram for the washer described above using the following pointers.

**Note:** Use seconds instead of minutes for cycle times to speed up the process simulation.

**INPUTS**

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>DESCRIPTION</th>
<th>TYPE OF CONTACT</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>High level switch</td>
<td>Normally open</td>
<td>Closed when water is present</td>
</tr>
<tr>
<td>X2</td>
<td>Low level switch</td>
<td>Normally open</td>
<td>Closed when water is present</td>
</tr>
<tr>
<td>X3</td>
<td>Start/Stop switch</td>
<td>Normally open</td>
<td>Closed when toggled high</td>
</tr>
</tbody>
</table>

**OUTPUTS**

<table>
<thead>
<tr>
<th>OUTPUTS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>Agitator motor</td>
</tr>
<tr>
<td>Y2</td>
<td>Spin motor</td>
</tr>
<tr>
<td>Y3</td>
<td>Drain pump</td>
</tr>
<tr>
<td>Y4</td>
<td>Add water valve</td>
</tr>
</tbody>
</table>

**COMMENTS**

**Programming:**
- Implement your controller using TAYLOR SOFTWARE. Have the TA initial your final draft of the program (printout from TAYLOR SOFTWARE) before you leave the lab. Keep this for later reference.

**Reports:**
- Your TA during the lab will hand out detailed specifications of your lab write-up.

**IMPORTANT HINTS AND ADDITIONAL REQUIREMENTS:**

1. Notice that this process, unlike the previous lab, is both time and event driven. Also, notice that some particular sequence of events is repeated during this process. One very effective way to design this feature is to use finish-flags. Design finish-flags to
indicate the end of the first two cycles (wash and rinse). Use these finish-flags to control the entire process. A finish-flag is merely an internal coil that is designed carefully to indicate the end of a sequence of events. At the end of the sequence, the internal coil should trigger on and stay on. It could be used subsequently to start or inhibit another event or sequence of events. The design of a finish flag using RLL, relies on a latching mechanism (to add memory – recall the coffee maker program, there is a latched coil controlling the ready light indicator. Ask your TA if this is not clear… ) and past inputs and event. Do not use the counters in this lab.

2. The start/stop switch is used to simulate power on/off in some sense. When power is turned on, all timers should be enabled, and the wash cycle started. When power is turned off, all timers should be reset, and all outputs shut off. When power is turned back on, the process should start over beginning, optionally, with the wash cycle, or at a later stage (this is a design option. Choose one for your own design unless otherwise specified by your TA… ).