The following sequence outlines the operation of the Water Dispenser System. There are many different ways to write a program to implement this sequence; however, the best way to write the sequence in LabVIEW is to use a **State Machine**. Your objective is to create a front panel design that interfaces well with the block diagram, but just as important, allows the operator to interact with the process. The basic State Machine will be constructed, but it will be up to you to refine the control system and improve it using LabVIEW tools. For example, you may choose to put in tip strips, text alerts, alarms, tank indicators for level, process lines and valves to show process flow and device status, a waveform graph for temperature, etc… Other improvements might include Front Panel property controls, such as removing the horizontal and vertical scroll bars, centering the front Panel screen, and block diagram error handling. Finally, be sure to fully document what is happening on the block diagram.

Your final project shall include a complete set of documentation as follows:

1. Title Page
2. Project Description, include this document.
3. Process & Instrument Diagram (P&ID)
4. Instrument or I/O List
5. Front Panel Design
6. Block Diagram

**SEQUENCE**

**Step #0 Home**

Pump off.

Fill Valve #1 and #2 off.

Drain Valve #1 and #2 off.

Heater off.

Conveyor off.

Press Start Button and proceed to Step #1.

If Stop button is pressed, then go to step #8.

**Step #1 Check Main Tank**

Fill Valve #1 and #2 off.

Drain Valve #1 and #2 off.

Heater off.

Conveyor off.

If main level is above 50%, then start pump and proceed to step #2.

If main level is below 50%, then stop pump and alert “fill tank low”

If Stop button is pressed, then go to step #8.

**Step #2 Fill Tanks #1 & #2**

Pump on.

If tank level #1 is below 20%, then open feed valve #1 and alert “tank #1 low”.

If tank level #1 is above 20%, then close feed valve #1.

If tank level #2 is below 20%, then open feed valve #2 and alert “tank #2 low”..

If tank level #2 is above 20%, then close feed valve #2.

When tank levels reach 20%, then proceed to step #3.

If Stop button is pressed, then go to step #8.

**Step #3 Move to Position #1**

Pump off.

Fill Valve #1 and #2 off.

Conveyor on until cup reaches first limit position.

When cup is in first limit position, shut off conveyor and proceed to step #4.

If Stop button is pressed, then go to step #8.

**Step #4 Fill Cup #1**

Pump off.

Feed Valve #1 and #2 off.

Conveyor off.

Open drain valve #1 for 5 seconds.

When timer is complete, shut off drain valve and proceed to step #5.

If Stop button is pressed, then go to step #8.

**Step #5 Move to Position #2**

Pump off.

Fill Valve #1 and #2 off.

Drop Valve #1 and #2 off.

Conveyor on until cup reaches second limit position.

When cup is in second limit position, shut off conveyor and proceed to step #6.

If Stop button is pressed, then go to step #8.

**Step #6 Heating**

Pump off.

Fill Valve #1 and #2 off.

Drain Valve #1 and #2 off.

Heater on until temperature reaches 100 degrees F.

When Temperature reaches 100 degrees F, then proceed to step #7.

If Stop button is pressed, then go to step #8.

**Step #7 Fill Cup #2**

Pump off.

Feed Valve #1 and #2 off.

Drain Valve #1 off.

Conveyor off.

Open drain valve #2 for 5 seconds.

When timer is complete, shut off drain valve and proceed to step #0.

If Stop button is pressed, then go to step #8.

**Step #8 Shutdown**

Pump off.

Feed Valve #1 and #2 off.

Drain Valve #1 & 2 off.

Heater off.

Conveyor off.

If the stop switch has been pressed, then shutdown LabVIEW.

If the stop switch has not been pressed, then go to step #0.

**SEQUENCE CHART**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **STEP** | **FV-1**  **FILL**  **VLV #1** | **FV-2**  **FILL**  **VLV #2** | **FV-3**  **DRAIN**  **VLV #1** | **FV-4**  **DRAIN**  **VLV #2** | **MS-1**  **PUMP** | **MS-2**  **CONV** | **TY-3**  **HTR** | **TRANSITION**  **CONDITION** |
| **0**  **HOME** | OFF | OFF | OFF | OFF | OFF | OFF | OFF | START BUTTON |
| **1**  **CHECK MAIN TK** | OFF | OFF | OFF | OFF | **ON** | OFF | OFF | MAIN LEVEL >50% |
| **2**  **FILL TK 1&2** | **ON** | **ON** | OFF | OFF | **ON** | OFF | OFF | FILL TANKS >80% |
| **3**  **MOVE TO POS 1** | OFF | OFF | OFF | OFF | OFF | **ON** | OFF | POSITION #1 |
| **4**  **FILL CUP #1** | OFF | OFF | **ON** | OFF | OFF | OFF | OFF | TIMER = 5 SECONDS |
| **5**  **MOVE TO POS #2** | OFF | OFF | OFF | OFF | OFF | **ON** | OFF | POSITION #2 |
| **6**  **HEATING** | OFF | OFF | OFF | OFF | OFF | OFF | **ON** | TEMPERATURE = 100oF |
| **7**  **FILL CUP #2** | OFF | OFF | OFF | **ON** | OFF | OFF | OFF | TIMER = 5 SECONDS |
| 8  SHUTDOWN | OFF | OFF | OFF | **OFF** | OFF | OFF | OFF | STEP COMPLETION |