Technology
Arts Sciences
TH Köln

Master's in Automation and IT

Instructor: Prof. Dr. Rainer Scheuring

Discrete Event Control : Automaton

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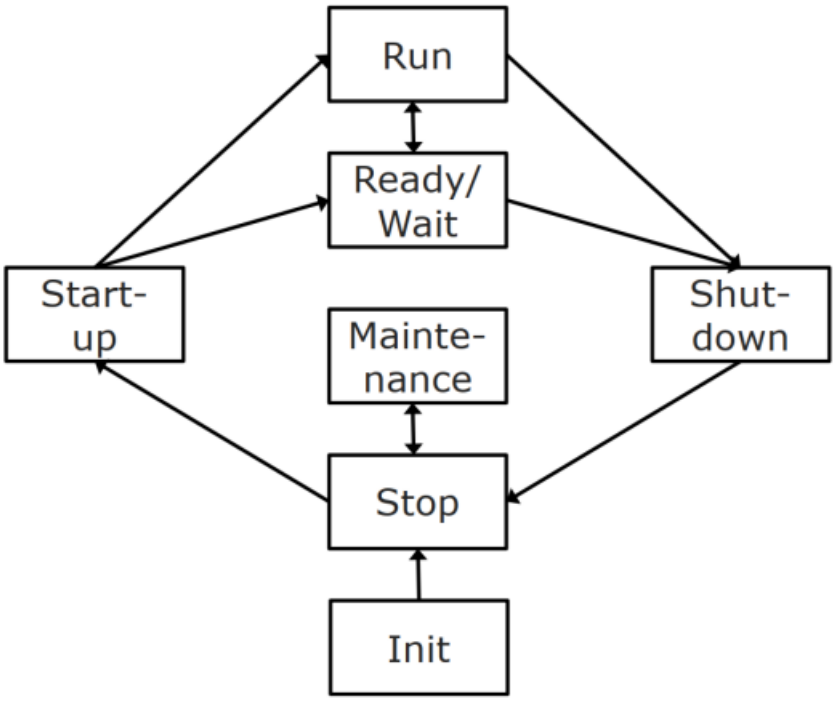
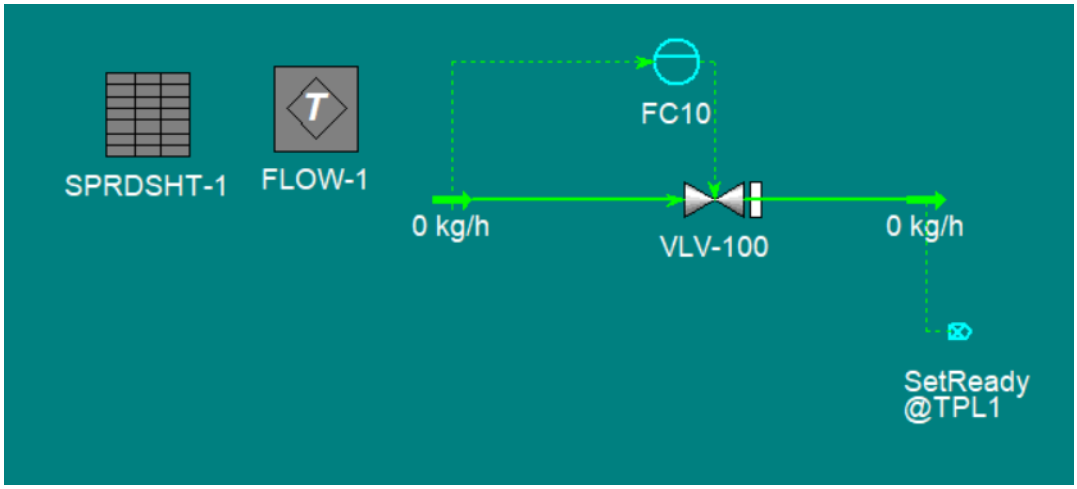
1 Problem Statement

Implement the following automaton using latches (flip flops):



2 Setup

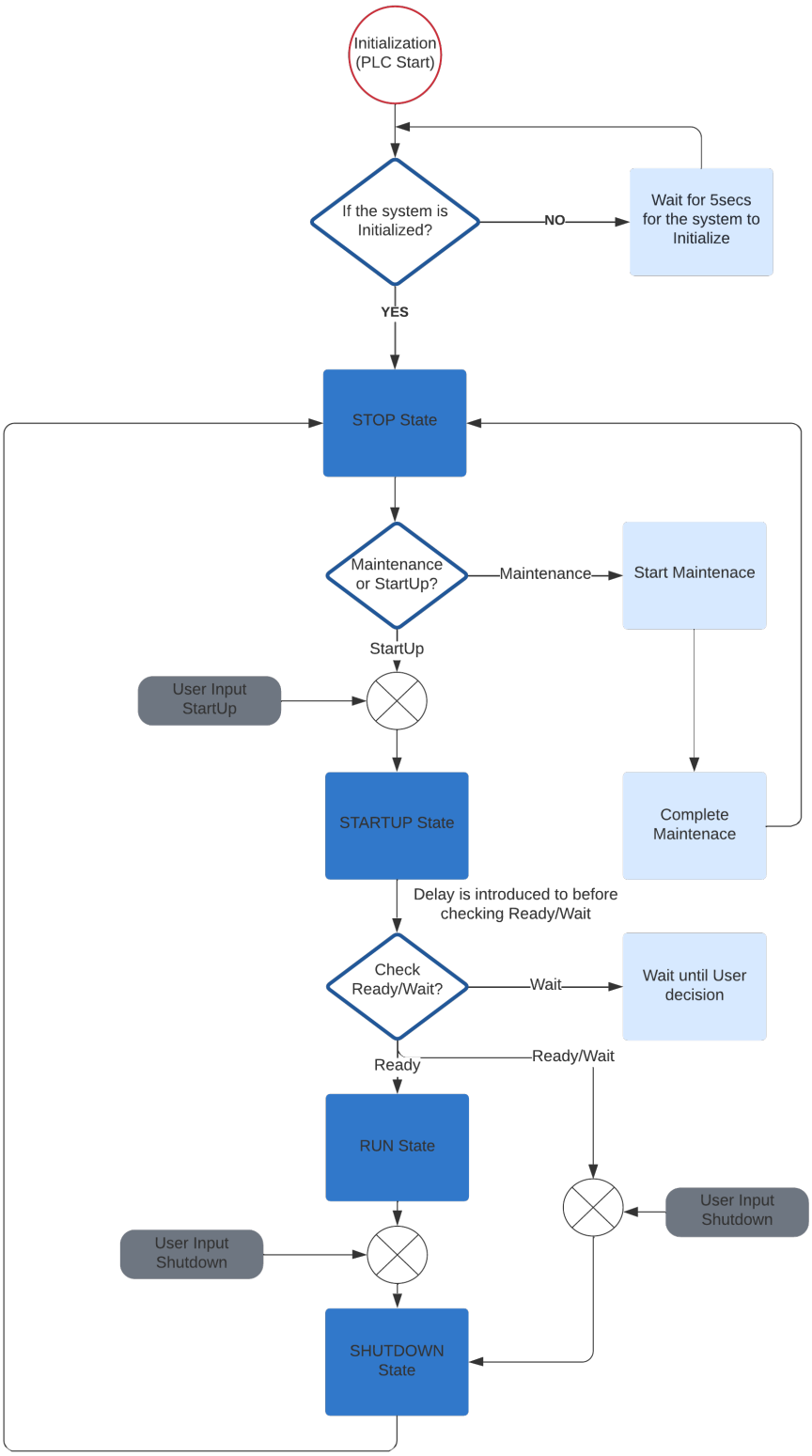


We used linear equal percentage valve for our simulation. Our setup includes a PID controller and linear equal percentage valve.

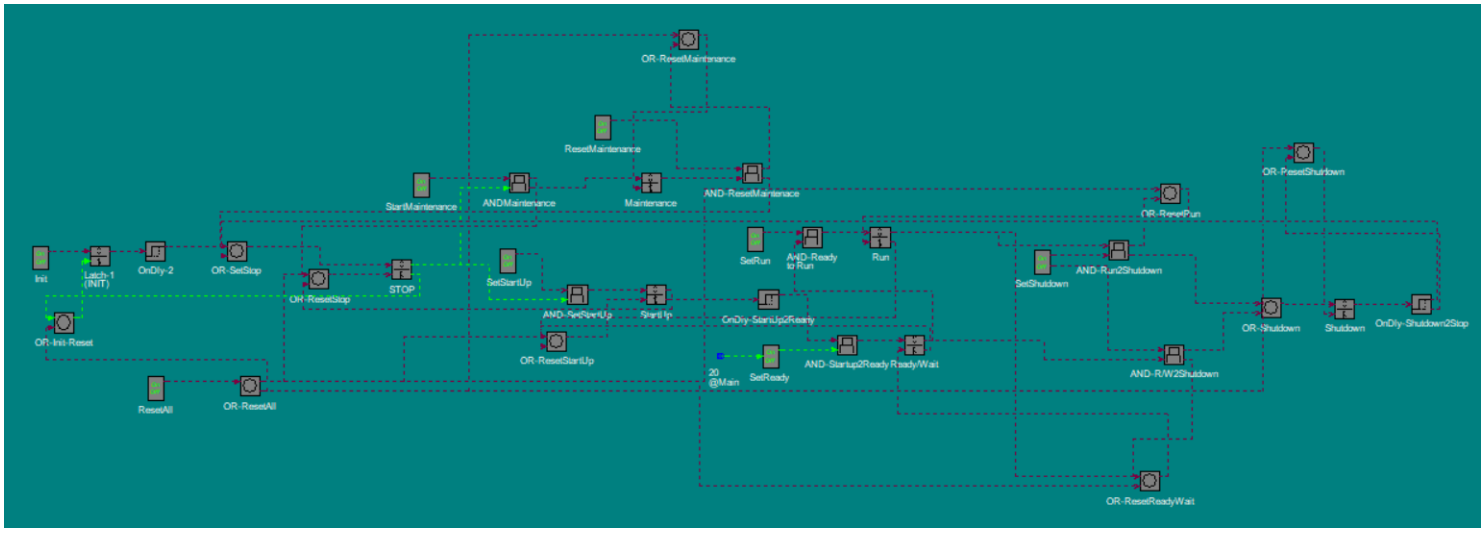
We created the sub flow sequence where we implemented automaton using latches. We used the spreadsheet to implement a short conditional logic statement i.e. when the valve should open (Run state) after the Ready/Wait state.

AND and OR gates are used in combination with SR flip flops to establish the sequence flow using the automaton. Each input should be returned back after it is triggered.

3 Implementation (Flowchart and UniSim)



We have implemented the above mentioned flow diagram in the UniSim simulation environment. Considering the problem statement we have executed the steps in the sequence where only one state will be active while the previous state tend to go back to zero state. Some of the states are customised according to the user flexibility and considering the real-time scenarios.



The sequence is as follows:

- Normally, when the system turns on for the first time there will be initialization state which will initialize the system for some prescribed time (5secs in this model). The initialization takes place after the user input.

- Once the system initializes, it will automatically go to stop state which is a must condition to startup the whole process. While the system is in stop state, it can either go to Maintenance state or Startup state depending on the user input.

why?- becoz everything is in off or stop and it should be

- Maintenance state is only possible when the system is in stop state and same applies to the Startup state. User has to manually trigger Maintenance whenever it is required and should acknowledge once the maintenance is completed by stopping the maintenance request.

- User input should be fed in order to proceed to the Startup state. Once the system is at Startup state it performs some pre-checks to make sure if the system is running fine.

- After that, system moves to Ready/Wait state. Delay is introduced before going to Ready/Wait.Ready/wait state checks for the Valve status based on the OP value. If the valve is fully closed, i.e., 0% then it means that the system is ready to be Run. So once the Ready/Wait state is active, Start Up state is reset.

- From Ready/Wait state, the user input is introduced to either go to Shutdown or Run state. This option is completely up-to the user how to handle the

system. User or Operator can either put the system into run mode or put it to shutdown if any anomaly is observed.

- If user input is introduced to go to Run state, then the signal is sent to the valve by changing its setpoint(SP) so that the valve is completely opened during the Run phase. We assume that the valve can be either 0% or 100% positions based on the latch output.
- When the Shutdown signal is sent by user either from Ready/Wait state or Run state, the system goes to the Shutdown state and after a delay of 10 seconds, it moves to Stop state again. The delay is introduced to enable proper Shutdown to Stop procedure. As we opened the valve when the Run state is enabled, same way we are closing the valve when there is shutdown sequence is enabled by the user. The valve will close from 100% to 0%. Further to this, the system will stay in Stop state until and unless there is a new command from an user.
- A separate user input is introduced to reset all the latches in the system.

We can use face plates for two purposes:

- Track all the state behavior at a given point of time.
- Register and control the digital inputs from the the user.