

M19COM Software Development and Design

Chemical Processing Plant Design Exercise – Week 9

A chemical process plant consists of one or more chemical reactor vessels. Each vessel has several inlet pipes and one outlet pipe. Each inlet pipe leads from one of several raw material storage tanks. Each outlet pipe leads to a product storage tank.

There are various sensors around the plant

- a pressure sensor in each reactor vessel
- a flow sensor in each pipe (inlet and outlet)
- a temperature sensor in each vessel and in each pipe
- a fluid level-detector in each storage tank

The sensors will give their current value when requested.

The system must measure:

- the flow rate in each pipe
- the temperature in each vessel and pipe
- the pressure in each vessel
- the fluid level in each storage tank

The system must also provide the following derived measurements:

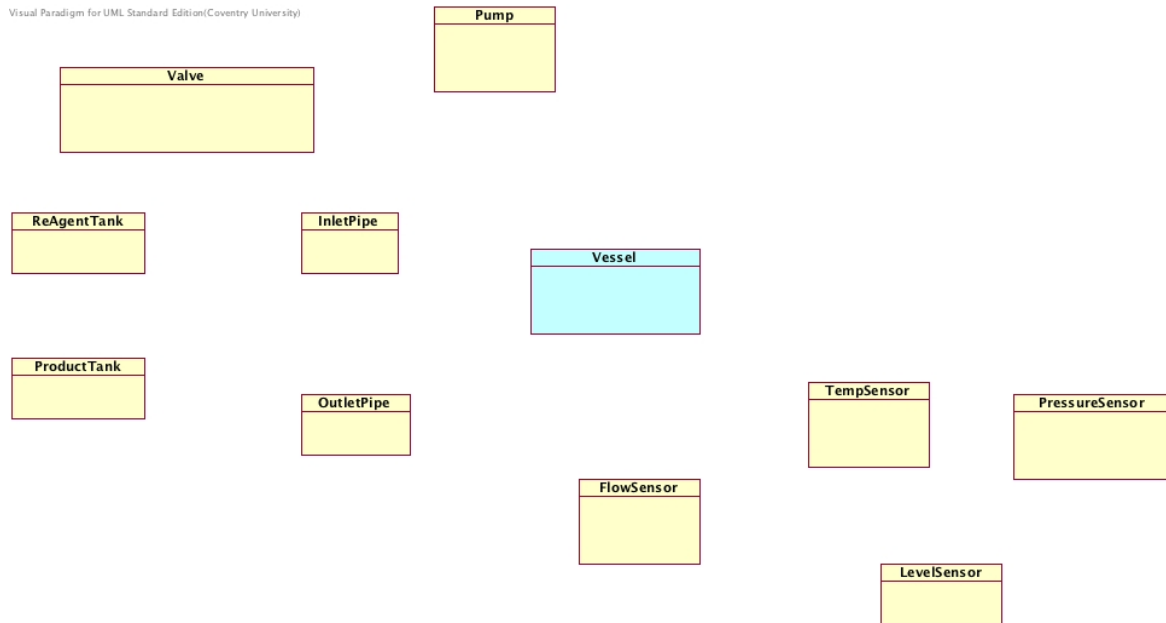
- Energy flow in each pipe (derived from temperature and flow rate).
- Pressure trend (derived from recent pressure readings)
- Temperature trend (derived from recent temperature readings)

The system has switchable on-off valves in the inlet pipes. It also has a variable speed pump in each inlet pipe to pump the liquid to the reactor vessel.

For each vessel the system continuously displays (to the user) all seven primary and derived measurements for each vessel, as well as the current time and date. Based on an overview of this data it also displays a summary status for each vessel (shutdown, normal, caution, danger).

The system will close down a particular vessel if its readings go out of safe range. This means stopping its inlet pumps, closing the inlet valves, and displaying a warning message to the user.

Below is an initial diagram of possible domain classes for the problem to help get you started:



Produce a layered partial design solution to a given problem (relating to a Chemical Processing Control System).

- You must make appropriate use of the GRASP patterns.
- In addition use *one* of the other high level design patterns described in course notes, for example the Observer pattern

The Design: can be produced using a UML CASE tool such as Rational Rose / Visual Paradigm or Star UML and must include:

- A design class diagram showing all relevant classes and the layers e.g. *Domain, UI, Application layers etc.*
- A sequence diagram for the main use case “display readings”.

All relevant attributes and operations should be shown in the class diagram. The diagram should also show the full specification of some of these attributes and operations as follows.

- 1) For classes that appear in the sequence diagram define the types of their attributes
- 2) For methods that are called in the sequence diagram give
 - The types of any return values
 - The names and types of any arguments