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1910594

by Dominic Davies

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Automatic Temperature Control System

By Dominic Davies

Company Background – Huntsman



- Huntsman is an American company founded by Jon Huntsman.
- Huntsman manufacture chemicals in 4 different business segments. These are Advanced Materials, Polyurethanes, Performance Products and Textile Effects.
- Llanelli plant is part of the Performance Products sector.
- The products manufactured at Huntsman Llanelli are:
 - DGA
 - Morpholine
 - Jeffamine
 - NMMO

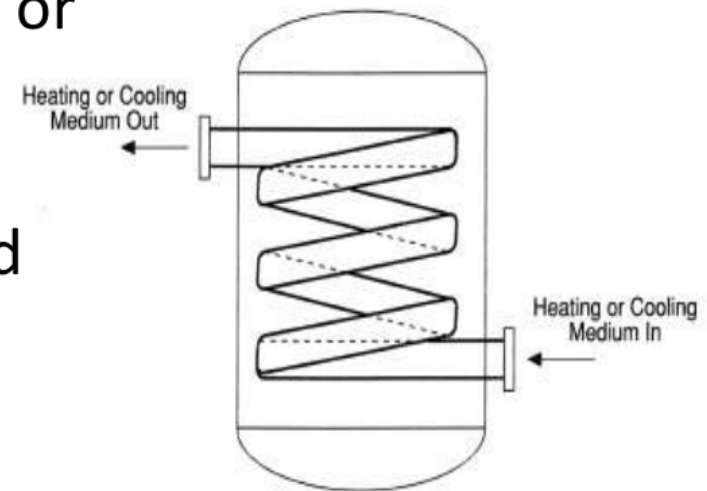
What do we do?

- The products that are manufactured in high pressure/temperature reactions and a process of distillation, are stored in tanks until it is ready to be shipped to customers.
- Product tanks to be kept at desired temperature.
- The tanks are kept warm in order to sustain the colour specification that the customer requires.
- It also improves the viscosity of the chemicals, making it easier to pump away.



Problem

- The current tank heating system is manually controlled on 1 block valve.
- All the product tanks are heated using a steam coil.
- When heating the tanks, despite having temperature displays, there is still a risk of overheating.
- The steam supply to the steam coil is either open or closed with no automatic control.
- Overheating of chemicals can cause them to discolour, creating problems for the customer and could become potentially unmarketable.

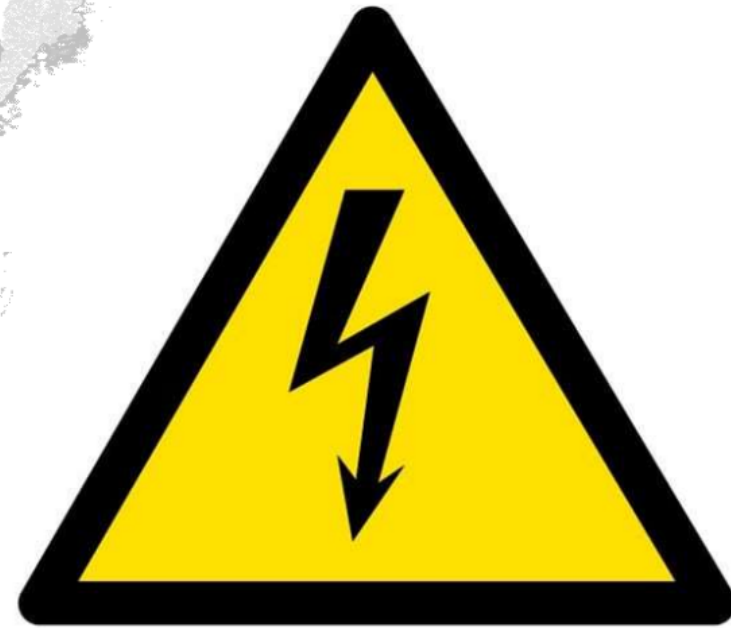


Functional Design

- The purpose of this project is to be able to monitor and control the temperature of fluids in a tank automatically.
- In this case, the 'product' in the tank will be water.
- There will be a temperature sensor constantly monitoring the temperature and feeding back to the PLC.
- There will be a temperature display on the HMI and the set point can be changed manually.
- The heater will then activate or de-activate in order to meet the set point entered by the operator.

Project Risks

- Falls, slips and trips in the workshop.
- Potential of working near live equipment.
- Incorrect tools used during tasks.
- Hot water splash.
- Cluttered workstations with sharp tools



Danger
Live electrical
equipment

Test Planning

Temperature Set Point (°C)	Heater Response	
	Activated (✓ / X)	Deactivated (✓ / X)
20		
30		
40		
50		

- 4 different set points.
- The heater must activate once the set point has been entered.
- The heater should then deactivate once the temperature exceeds the set point.
- The heater should 'flick' on and off to maintain the temperature.

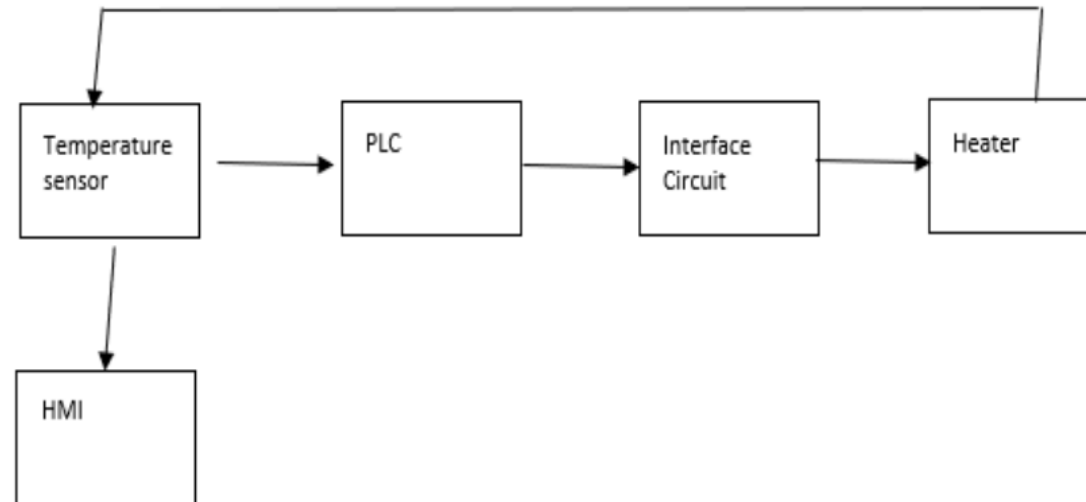
Solution 1

Here, an automatic temperature control system will be operated using a PLC.

The PLC will be programmed to keep the temperature of the water at a desired set point with a tolerance of $\pm 5^{\circ}\text{C}$. This set point can be altered.

A temperature sensor will be used to monitor the temperature of the water and will display the current temperature on the HMI.

The heater will be turned on and off automatically in order to meet the set point. For example, if the temperature is 15°C , and the set point is 30°C , the heater will be activated. Once the temperature exceeds $30 - 35^{\circ}\text{C}$, the heater will be turned off.



Solution 1 (Chosen Solution)

Pros

- Familiar with PLC programming.
- Accurate
- Cheaper

Cons

- Difficulty with changes or replacements.
- Siemens 1214C PLC - £400, Heater - £40, Circuit components - £20, Temperature sensor - £35

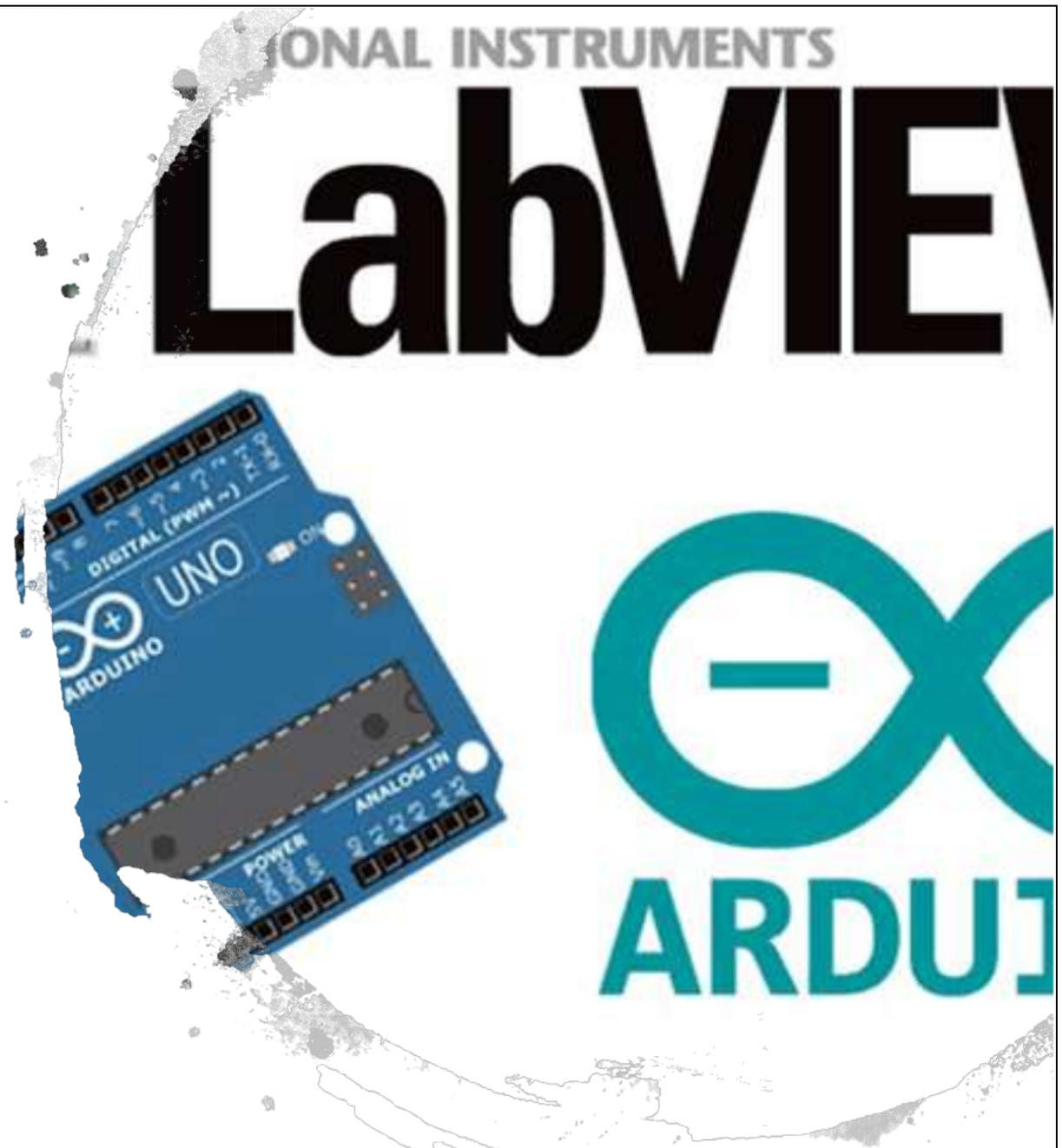
Total - £495 - £500

Solution 2

Here, an automatic temperature control system will be programmed using an Arduino which will be further connected to LabVIEW software.

LabVIEW will be used to design and implement the process and will control the temperature of the water ensuring it doesn't go beyond the setpoint.

The Arduino will be programmed to do the same job as the PLC.



Solution 2

Pros

- Easy to interface with instrumentation and other communication links.

Cons

- Expensive (LabVIEW full license £4000 alone).
- Inexperienced in Arduino programming.

Arduino - £20, LabVIEW license - £4000, Heater - £40, Circuit components - £20,
Temperature sensor - £35

Total- £4115

Gantt Chart

Activity	Week Number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Research project Ideas																
Research project																
Proposal																
Another Solution																
Presentation																
Specification																
Source and Order components																
Project Construction																
Testing																

[illegible]



Thank You for Listening

FINAL GRADE

GENERAL COMMENTS

66/100

Instructor

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DOMINIC DAVIES

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RESEARCH-INFORMED LITERATURE

 Project background was explained clearly and included good relevant detail. 7/10 There is evidence of research. 6/10

13/20

KNOWLEDGE AND UNDERSTANDING

 Project purpose was identified and explained in good detail. 3/5 Project constraints and risks were explained and associated with company policy along with codes of practice and standards. 3/5 Environmental and sustainability were covered very well in the question section. 3.5/5 Functional design was explained clearly and demonstrated a good understanding of what the application involved. 3.5/5 Response to questioning was good and included relevant detail. 7/10

20/30

ANALYSIS

 Project was defined clearly and a good explanation was given. 3/5 Functional design specification was good with good relevant details. 7/10 A good argument given for the choice of final solution. 3/5

13/20

PRACTICAL APPLICATION AND DEP.

 Design specification included relevant details and was explained clearly. This was aided with a block diagram. 3.5/5 Argument for critical choice of final solution was explained well and key points were identified. 7/10 Project plan was good and the timeline is compared with actual timeline. 3.5/5

14/20

SKILLS FOR PROFESSIONAL PRAC.

 Slides include relevant details and were informative about the project. 3/5 Overall delivery was good. 3/5

6/10