

PSDE4033 Assignment 2

by Thomas Jones

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PSDE4033: Final Report and Logbook

ASSIGNMENT 2

*No table of contents and no list of
figures. This is poor in any report.*

Thomas Wyn Jones
Word Count:3056

1. Introduction and background research

Line 3 is a press line in the press shop in Gestamp Llanelli. On this particular line there are 5 presses including a double action press. Each one of these presses has its own hydraulic tank which is located in the basement underneath the press. The hydraulic tank sends oil to applications such as the metered lube system which provides lubrication to various mechanical applications such as the counter balance cylinders and provides lube to the con rods of the press. The hydraulic tank also provides oil for the hydraulic overload. The hydraulic overload is a protective valve which protects the press from a mechanical overload.



Figure 1: Picture of Line 3 after its installation

Line 3 is one of the newer press lines, which was imported from America. These presses have a level sensor in the hydraulic tank, which has only one set point. Once the level in the tank drops below the set point the line will stop running until the set point has been made once again. This creates unnecessary downtime for production as this can be prevented by the level switches being able to send a warning to inform the operator that the tank needs filling.

The technical support engineer has requested that the current system in place be overhauled and modernised. This new system will need to have a sensor which has the capability for multiple set points. Two setpoints have been discussed, one which will stop the line when the oil level in the tank drops too low and one which will warn the operator that the oil level needs to be filled.

*The task is identified here
which is a good point.*

2. Specification

The project will be based in the press shop in the Gestamp manufacturing plant in Llanelli on Press line 3.

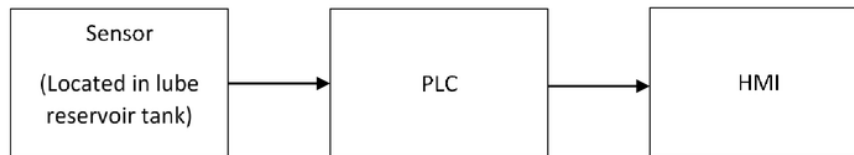


Figure 2: Block diagram of project

Each press on line 3 has its own hydraulic tank. The current setup on the tank has a level switch which only has one set point. Once the level in the tank drops to a certain point the line will stop running and will not be able to reset until the level in the tank has been filled. By the time the line stops, and the operator informs the team leader the line is down, maintenance will then be called to deal with the breakdown. This can cause downtime of up to half an hour, perhaps more if members of maintenance are occupied on other jobs. If a system which has multiple inputs and can facilitate a warning set point is implemented, maintenance can be called and fill the level of the tank up before the machine stops.

The technical support engineer has decided that the old system needs modernising. A new system will need to be researched, designed and implemented.

For this project a budget of £400 has been granted by the maintenance department. This budget covers the cost of the sensor itself, any additional accessories with the sensor and the cost of the cable that will need to be run. The budget does not include the cost of labour when it comes to running the cable, which will be done by contractors. The timescale for this project has not been defined. Contractors are scheduled to run the cable sometime in January. After the cable has been run, the maintenance supervisor must give permission for this to be done on a weekend. A technical support engineer will need to be there to assist as well. As there are multiple jobs waiting to be completed the exact time for this job to be completed is not clear.

3. Planning

Avoid using first person terms

A Gantt chart has been designed to outline the planned schedule of this project. As the Gantt chart shows there are multiple stages to this project. As I have other duties other than this project, the planning portion of this project takes longer than it would normally take. In the Gantt chart there are two rows for each stage; one for the time planned to undertake each task and the actual time it took to complete each task. The planned section is highlighted in **blue** and the actual time taken is in **red**.



Figure 3: Gantt chart

Good use of Gantt chart which compares planned and actual time lines.

4. Solutions considered

As part of the assignment brief three solutions have been outlined. These three solutions are capable of solving the problem stated by the specification. The three solutions have been compared and analysed against each other below.

Ultrasonic Sensor

An ultrasonic sensor utilizes sound waves to measure distance. A transducer sends and receives ultrasonic pulses which relay the information back to the sensor via an 'echo'.

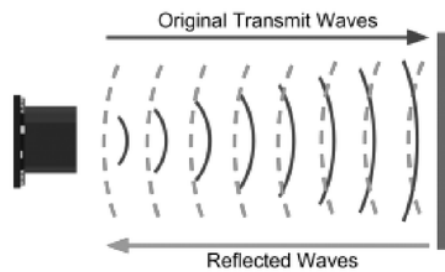


Figure 4: How an Ultrasonic Sensor works

(Burnett, n.d.)

When mounting an ultrasonic sensor into a tank the location is key. The sensor has to be located away from the walls. If this was to happen there would be interference from the walls of the tank and the readings would be skewed.

Ultrasonic sensors are typically more expensive than its more simple counterparts such as float switches however give an accurate reading

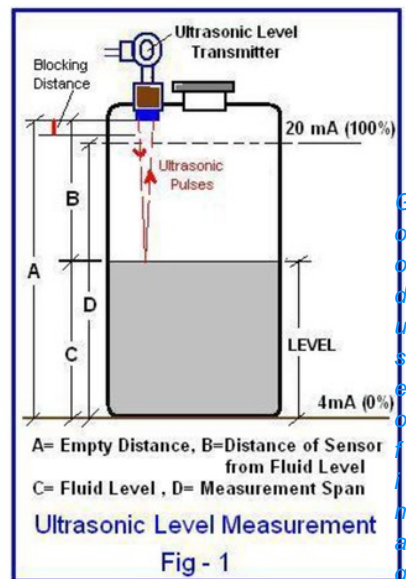
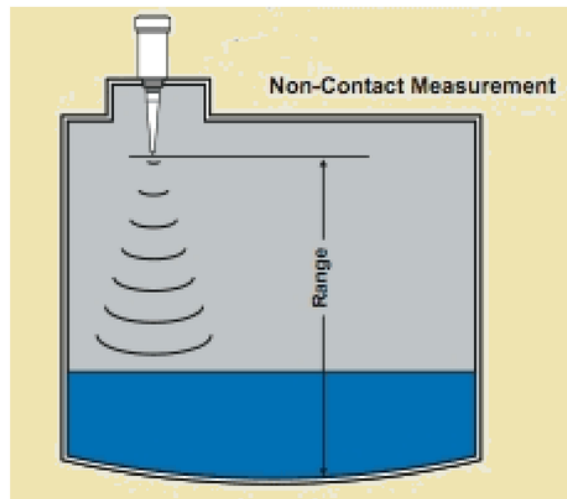


Figure 5: How an ultrasonic sensor works

(Coulton, n.d.)

Microwave sensors

Microwave sensors are becoming an increasingly popular choice for level switches. Microwaves use electromagnetic energy and do not need air particles to transmit energy. Which make them a popular choice in vacuums. Microwaves are reflected by materials such as metals and conductive water which have high conductive properties. Microwave sensors also do not require contact with the liquid to be able to take a reading, therefore both the transmitter and receiver can be mounted in a safe location. The main negative for microwave sensors is the cost and set up. (Impress-sensors, n.d.)



Good image to support explanation

Figure 6: Microwave sensor operation

(Inc., n.d.)

Float switch

A float switch is an old fashioned way to detect the current level inside a tank. The most common type of float switch which is present in Gestamp uses a float with a magnet inside which makes a reed switch depending on the level of the tank. It is common to see multiple reed switches for multiple indications of the level of the tank. Float switches are considered old technology and modern equivalents are now preferred. However float switches are tried and tested and have good reliability. However as float switches are mounted inside the tank, should a fault occur it can be difficult to access the switch to fault find. The cost of a float switch would be significantly lower than the other two suggested solutions, with a suitable model costing just under £100. An example of what this would look like in a tank has been demonstrated by Cristal Instruments below.

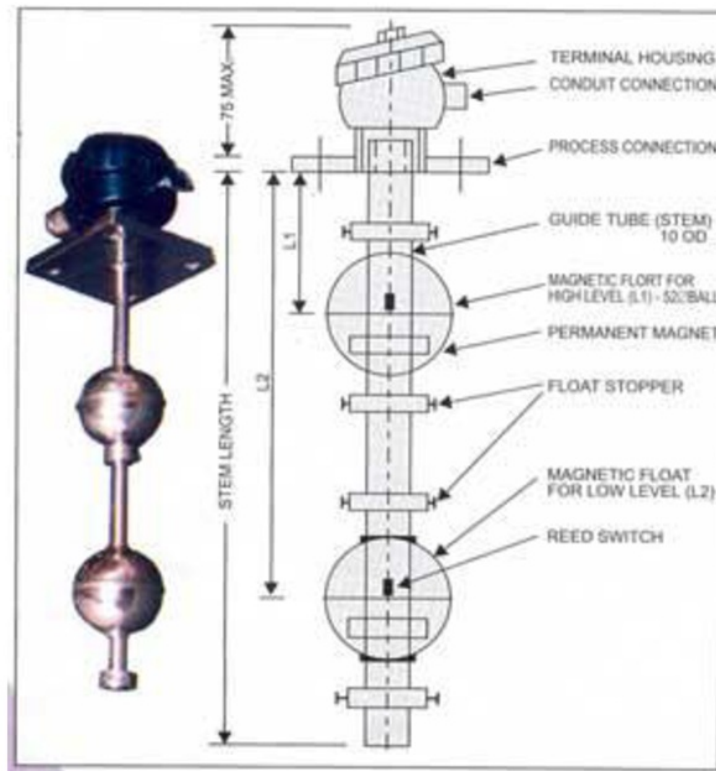


Figure 7: Float switch operation

The request that has been given from the technical support engineer is to modernise the current system. Therefore using old technology such as a float switch is not realistically appropriate. Especially considering accessing the switch in a fault situation. This rules float switches out of contention. It then left a choice between microwave level sensors and ultrasonic sensors. They are both similar pricing and both can be achieved under the budget of £400 per tank. After looking at various models for both microwave and ultrasonic sensors. It was decided that ultrasonic sensors were going to be the most suitable choice. Additional software was researched to assist with programming the sensors. To assist with the decision making of the level sensor a table comparing the three was devised:

Table 1: Comparing three alternative solutions

	Ultra-Sonic	Microwave	Float Switch
Cost	High (£250).	High (£250).	Low (£80).
Reliability	Very good (if set up correctly).	Very good.	Good.
Ease of use	Easy (if accompanying software is purchased with the sensor).	Easy (if accompanying software is purchased with the sensor).	Very easy.

<i>Setup</i>	Dependent on the tank, cannot be mounted near walls of tank.	Dependent on the tank, cannot be mounted near walls of tank.	Varies depending on the type of float switch. Some can be intrusive and awkward to.
<i>Fault finding</i>	Easy	Easy	Dependent if float switch is accessible.

Table of comparison is good and an easy and effective method of evaluating the solutions.

5. Final solution design and implementation

Below, an image has been created of roughly what the tank will eventually look like with the level switch mounted. The potential setpoints have also been added to the diagram. As previously stated the solution that has been decided is an ultrasonic level sensor.

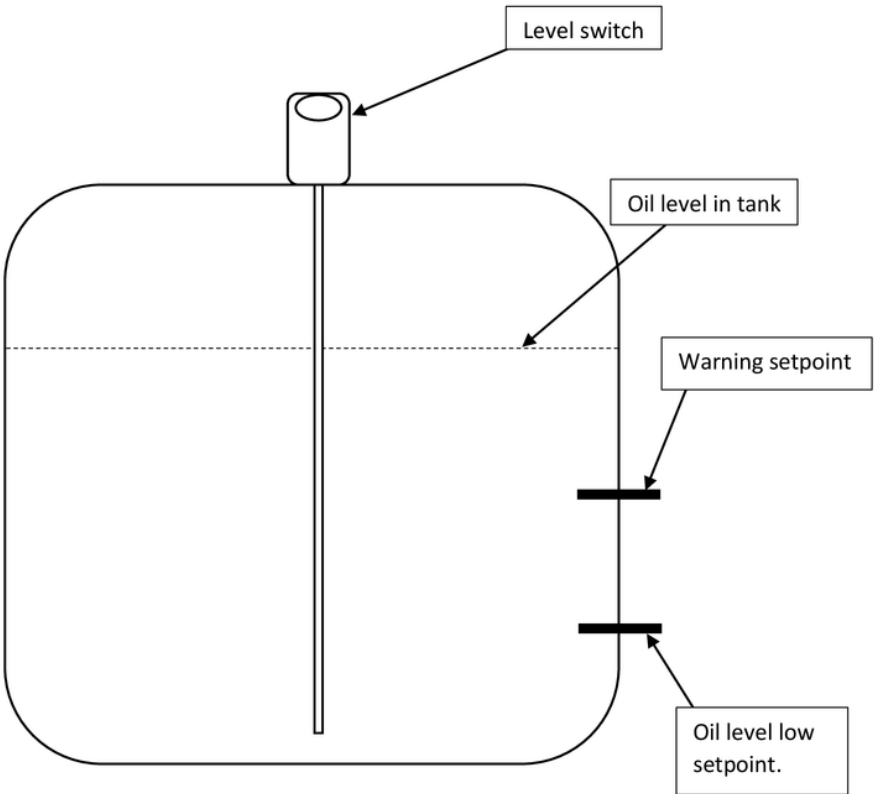


Figure 8: Diagram of what project will look like

The ultrasonic level switch that has been chosen is the IFM Lr2050. After researching the data sheets for various level sensors, it was decided that this would be the best choice. This is because it has the capability of using both digital and analogue inputs. For this project, only digital inputs will be required. This sensor can have multiple inputs which matches what has been specified in the specification at the start of the project. This level switch cost £406.70 for the sensor itself. Other components were required. A coaxial pipe was also bought to be fitted with the sensor, for a 240mm pipe the cost is £45.80. To successfully mount the sensor to a tank a flange plate is also needed. The cost of this plate is £28.00. The final accessory that was bought was the software needed to program the sensor. The cost of the software plus the I/O link that was also purchased was £324.70.

Item	Cost
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Figure 10: Warning input programming

The task here is very simple and for the project some enhancements should be included such as a comparison or an analogue method

The first stage of the implementation was to locate a container. This container must meet two conditions. It must have a top to mount the sensor on and it must be able to store liquid so the sensor can be suitably tested. An empty tin was sourced. *Avoid first person terms.*

Once all the components were gathered the sensor could be assembled. I firstly applied 24V to the sensor to ensure that the sensor worked. The sensor switched on as expected as the below picture illustrates.



Figure 11: Sensor with power

An instruction book accompanied the sensor which was used throughout the implementation.

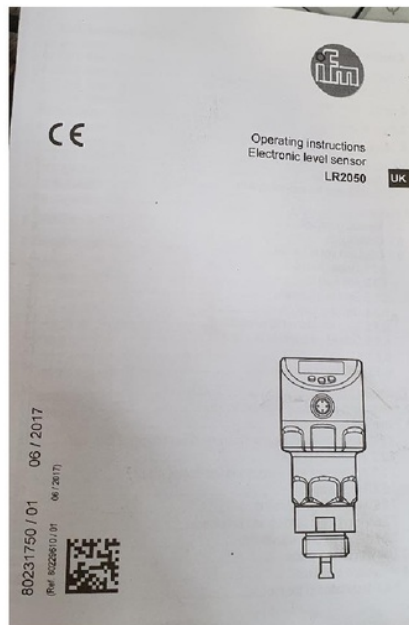


Figure 12: Operating manual for level switch

Next the rod which came with the sensor was attached to the sensor. This rod needed to be shorter than the depth of the tank.



Figure 13: Probe attached to sensor

Before the sensor can be mounted, the coaxial pipe and the flange are assembled and joined to the sensor. With these connected, the sensor is now ready to be mounted. The below images shows the coaxial pipe and flange joined and the sensor with all attachments connected ready to be mounted. 4 holes were marked out and drilled so the flange plate could be mounted. The sensor is now attached to the lid of the container. The below picture shows the sensor mounted to the lid and power attached to the sensor with a display.



Diagram supports the explanation

Figure 14: Sensor mounted to flange plate and mounted to lid



Figure 15: Flange plate with coaxial tube

Where is the HMI part of the project for visual feedback. The spec states a HMI is required.

6. Testing and results

As this project was simulated on the workbench and not on Line 3, which is where it was originally intended to be installed, the level switch was simulated on the workbench in the electrical workshop.

The simplest way to test the operation of the level switch was to use the parameters that have been set up during the design implementation. 2 set points have been programmed and now they must be proven to work. To test this the lid in which the sensor was mounted on was raised and lowered to change the value of the sensor.

To remind ourselves, the length of the rod is 255mm and the reading shows how much of the rod is submerged in liquid. Two set points have been programmed; one as a warning which is set at 100mm and resets at 120mm (Output 2). The other set point is for low level which has been programmed at 50mm and will reset at 70mm (Output 1).

The below image shows what the sensor reads when the container is 80% full, with 202mm of the 255 mm rod submerged in water. As the picture illustrates both output lights are on.



Figure 16: sensor readout on 80% full

Firstly output 2 was tested, to do this the sensor was raised until the reading dropped below 100mm, as the below picture shows the output indicator switched off as intended.



Figure 17: testing set point 2

To stop the output switching on and off as the liquid level fluctuates the level needs to reach 120 for it to reset and the output to switch back on. The picture below (left) shows the set point and the reset point of this output. The picture on the right shows the sensor at 121mm and as the picture shows that the output has reset.



Figure 18: Software programming and output 2 resetting

Now that output 2 has been proven to function, output 1 can be tested. The two pictures below show the sensor just above the set point of 50 and just below. The output can be seen to switch off once the level drops below 50mm



Figure 19: Level of sensor just above output 1 and when the level drops below 50mm

For this output to be reset the level in the tank has to be taken to 70mm. Once this has been reached the output will reset and be on again. The below picture illustrates this.



Figure 20: Output 1 resetting

A testing table was produced detailing each phase of testing, this was done to keep track of the project and to ensure that the specification was being met:

Table 2: Testing table

Test undertaken	Expected result	Actual Result	Success? (✓/X)
Downloaded parameters from level sensor onto software.	The parameters on the sensor will download and can now be viewed and modified.	Parameters downloaded from level sensor and sensor can now be programmed.	✓
Output 1 programmed and tested for functionality. Ensure that set point switched and reset at correct levels.	Output will switch off at correct level and will reset when tank level reaches desired point.	Output switched off as expected and reset when level reached requested amount.	✓
Output 2 programmed and tested for functionality. Ensure that set point switched and reset at correct levels.	Output will switch off at correct level and will reset when tank level reaches desired point.	Output switched off as expected and reset when level reached requested amount.	✓

Ensured both outputs work in tandem.	Both outputs should function together when tank varies from full to empty and both should reset when the tank is filled back up.	Both outputs switched off and reset when tank was emptied and filled.	✓
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*Testing methods are good and the use of a table of results is a good method for evaluating outcomes.
The HMI should be implemented and tested as the spec requires.*

7. Discussion, Conclusions and Recommendations

Due to unforeseen circumstances, this project was unable to be implemented on Line 3, which was what was originally intended to materialise. Therefore, the project was designed and successfully simulated on the workbench. The specification states that the current system be overhauled and modernised, this has been done by replacing the redundant level switch with an ultrasonic sensor. The specification also requests that two set points are required; one set point used as a warning and the other as a low level set point which will prevent the press from operating. When the level in the tank drops below these set points, the level needs to be exceeded for them to reset, this is referred to as the reset-point. This is to prevent the output from oscillating between on and off when the oil is swilling.

As this project has met the specification which was detailed in Task 2 it is fit for purpose. The system has been modernised and downtime regarding the oil level in the tank should disappear. The budget of this project was £400. The cost of the parts (minus the software) is £480. This is above the budget which was allocated at the start of the assignment. This issue was cleared by the technical support engineer before anything was bought.

8. Reference list and Bibliography

References

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*There could be more refs
and more academic sources
used.*

PSDE4033 Assignment 2

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

41 / 100

PAGE 1

Text Comment. No table of contents and no list of figures. This is poor in any report.

PAGE 2

Text Comment. The task is identified here which is a good point.

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PAGE 21

PAGE 22

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GRADING FORM: CSG-RUBIC

THOMAS JONES

0

RESEARCH-INFORMED LITERATURE



There is not much evidence of research besides the background research. Only four in text refs are used and two are for images only. poor effort here. 3/10
The number of references is not appropriate for the report. However the online refs include the date accessed. This is the Harvard spec. More refs should be included and used in the report. 3/10

6/20

KNOWLEDGE AND UNDERSTANDING



The specification is reasonable but could be clearer on the requirements. However you have included a block diagram of requirements overview. Nothing is mentioned about sustainability and environmental issues even though they must be covered as part of the industry protocol. 5.5/10
Solutions considered shows an understanding of what is needed for the system and there is an evaluation for the solutions. There is no mention of the HMI or similar in the solutions as this is required according to the spec. A reasonable effort . 5.5/10

11/20

ANALYSIS



Testing and results is comprehensive for the sensor but this cannot justify the solution choice because the HMI or equivalent is missing. There has been a reasonable effort made in this section even though there are parts missing. 5/10 The conclusion and recommendations cannot be accurate because the spec has not been met. There is no HMI feedback or equivalent implemented or tested. 3/10

8/20

PRACTICAL APPLICATION AND DEP.



The planning for the project using Gant charts is good and shows the predicted and actual timeline comparison. 3/5 Solutions considered are reasonable. Practical testing has been carried out on the chosen solution only but you have carried out a reasonable evaluation of the solutions. There is no application of the HMI which is required according to your spec. 5/10 Implementation has only been partly completed for the chosen solution. The PLC program is explained and tested but nothing about HMI. 5/10

10/20

SKILLS FOR PROFESSIONAL PRAC.



The report was not structured very well and there is no contents or list of figures. This is a poor effort.

6/15