Project Aim

To understand the fundamentals of industrial control and automation systems by developing, programming, testing, and documenting a train crossing control simulator.

Over my project I investigated -

• The basics of industrial control systems

• Programmable Logic Controllers (PLCs), including inputs and outputs

• Sequencing, control logic, and automation software

• How control systems are designed, tested, and documented

Proeon background

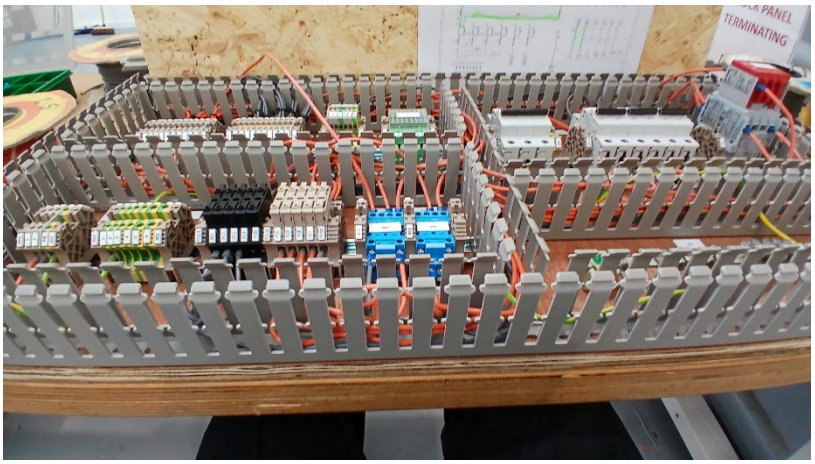
Proeon Systems is a Norwich-based specialist engineering and systems integration company, headquartered at 35A Barnard Road in the Bowthorpe Employment Area. The company designs, develops and delivers industrial control, automation and safety systems for complex and highly regulated industries, including renewable energy, offshore wind, nuclear, utilities, oil and gas, manufacturing, pharmaceutical and chemical sectors. Its Norwich operation brings together engineering, research and development, manufacturing, testing and project support.

Manufacturing and Assembly

Due to Proeon already having the train simulator we didn't make it. However, to simulate the process we learnt the processes through mock panels used to train new staff. This taught us how the train simulator was

manufactured as well as how to follow technical drawing with the correct wires and colours.

The mock panels that we made were smaller and larger versions of the train simulator which didn't have a purpose apart from teaching us how panels are assembled.



Calculations and Testing

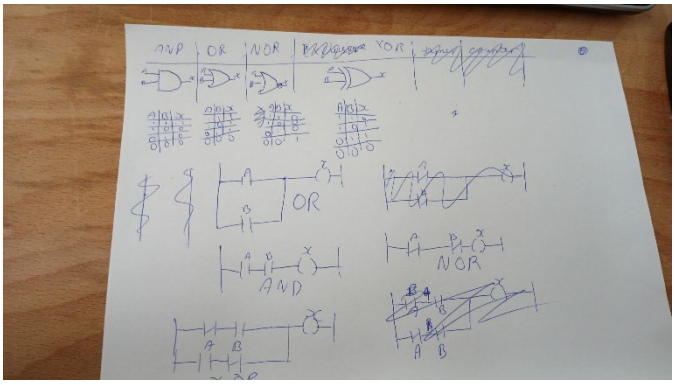
Before we calculated the heat and load calculations, we had to make a BOM (Bill Of Materials) for the train simulator. This was to identify what was required to make the simulator and to make finding the specification sheets easier. After that, we calculated the heat that would be produced by all the components (e.g. PLC, I/O module, wires, etc.). This was done with a spreadsheet that Proeon uses as a template on Excel and using the pre inputted formulas on the spreadsheet. The maximum operating heat was gathered from the product specification sheets found online. If the heat produced exceeded the maximum operating temperatures a fan or ventilation system would have to be installed.

After we had completed the heat calculations the load calculations were next. A similar process was used where we looked at the BOM to find all the components and went to the specification sheet where the required load was and inputted it into the spreadsheet. This would then calculate what input voltage was required and showed where transformers and resistors were required in the system depending on the voltage and current required.

Finaly, after doing all the calculations we had to test the system to ensure that all the components had continuity and operated correctly. Before that we had to ensure that the system was dead and had no voltage running through it. After we confirmed that it was dead we took a multimeter and tested the continuity of the system using the drawings for the system to guide us.

PLC Programming

To program the PLC, we used a piece of software called TIA Portal V18. This was the company standard at the time for projects with version 18 being the standard for the train crossing project.

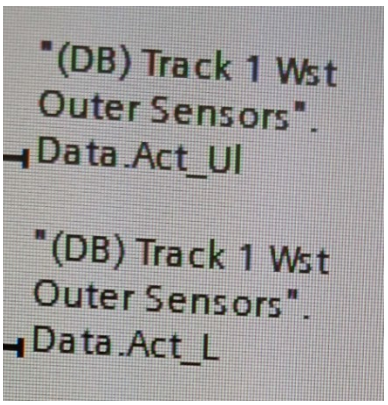


Before we started developing the ladder logic, we first needed to understand how to represent different logic gates using ladder logic. As you can see in the image to the left, we drew the ladder logic for some gated including, OR, AND, NOR and XOR.

After we had learnt the different ladder logic for these gates we went on to learn about the software that we were using to program the PLC (TIA Portal). This was done to ensure that we understood how the software worked.

Before we started programming, we had to make sure the software could identify the PLC and I/O Card which was in the train simulator. We did this by using the product number and inputting that into the software for it to be recognised.

After the PLC and I/O Card had been identified we started with inputting input tags, output tags and memory tags. These will be used by the software and us to identify which input/output the PLC should use in different sections of the code. Bolow is a couple examples of tags we used in the program.



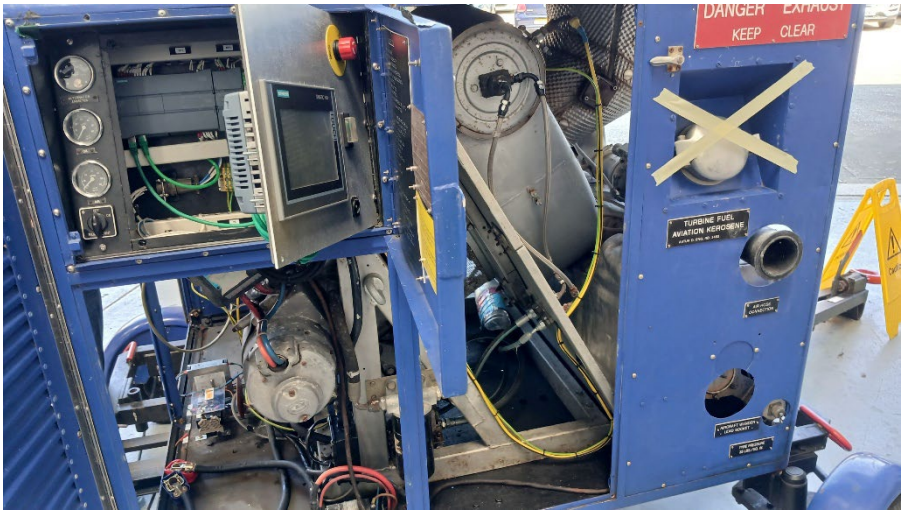
HMI Development

Developing the HMI was a similar process to the PLC where we first had to identify what HMI we were using. After we did that, we had to design what the different screens where in the software including history, visual representation and a home page. These were all made in the TIA Portal software. Unfortunately, we were unable to complete the full HMI due to how long we were placed at Proeon, however we completed all the other HMI functions apart from the train moving across the HMI.

Additional Work

Alongside the train simulator project, we assisted in restoring Proeons gas turbine. The gas turbine hadn't been operational since before they had moved from their old site 18 months before the internship started.

In this restoration we assisted by cleaning the turbine and making it look cleaner. After this we completed a visual inspection of the machine to identify any problems that may become apparent if it was fired up. Once we completed the visual inspection, we had to do point to point testing on all the connections that were accessible. Due to time constraints, we were unable to assists any further however the next steps would be to fire up the HMI and ensure that the software is all there and working.



Skills and Knowledge Gained

Overall, from this internship I have gained more knowledge than what I had expected with learning a new piece of software (TIA Portal), learning about gas turbines and how they operate, and the practical skills to put together an electrical panel. I have also discovered that Proeon could be a place I consider asking for an apprenticeship in the future. As well as the practical skills I have gained from this internship, I have also gained knowledge of what a working environment is like in reality and experiencing it.

Reflection and Improvements

Overall, from my experience at Proeon, one of the largest challenges that I faced was learning TIA Portal and how the software worked due to it being new and different to what I have done in the past.

Another challenge that I faced at first was understanding the drawing and using them to make a panel. I quickly overcame this with tips from some of the Proeon staff.