ELECOMP CAPSTONE
VIRTUAL SUMMIT
FRIDAY, MAY 7, 2021

THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO™

Data Collection Using IIoT

Industrial Internet of Things

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Project Motivation

Supfina Machine Company is one of the largest suppliers of abrasive finishing machines and attachments. Their machines improve the surface geometry of parts using a variety of abrasive media, with a focus on automotive parts and bearings. Recent developments in software technologies have created room for improvement in the machining industry. Supfina aims to stay on the cutting-edge and ahead of its competition by developing an IIoT data collection system for its machines. With IIoT facilitating data collection, this system will allow engineers to analyze trends more efficiently than before, detecting flaws and allowing workers to plan for downtime long before it starts. Our design makes use of modern hardware and software, with industrial grade sensors communicating via IO-link to transmit process data. Eventually, this data will be forwarded to the cloud-based storage system via the eWON Flexy data gateway, allowing it to be analyzed and viewed by customers and engineers at Supfina.

Key Accomplishments

Sensor Selection: The sensors selected for this project were flow rate, temperature/humidity, air consumption, vibration, and power consumption. To verify that the chosen power meter sensor was adequate, we consulted with a sales representative from Accuenergy, providing him with specifications and the intended use. We were then provided with various options but ultimately chose the power consumption meter capable of rated for 480V, 3 phase, 60 hz and the communication module is IO-link compatible. The air consumption sensor collects flow and temperature. The flow rate sensor is rated for water, oils and air, has IP67 rating, and is capable of measuring up to 100 bar. The temperature and humidity sensor detects various physical variables such as vibration, temperature, relative humidity and barometric pressure. Which reduces the costs of getting separate sensors to collect the variables separately.

Communication Protocols: In the industry there are a variety of communication protocols used for data transmission between hardware and servers. At Supfina Machine company the primary communication protocols implemented in their machines are EtherNet, IO-link, and analog. When searching for the sensors we primarily searched for IO-link enabled hardware. IO-link facilitates monitoring, diagnostic capabilities, and creates an easier to follow wiring system. As it requires less wiring due to transferring and receiving data over a single wire, being the M12 connector. Many IO-link enabled sensors can be connected to a master switch, which is then connected to the PLC via ethernet. Some sensors are not IOlink and use serial communication instead which requires extra hardware to be able to send the data to the PLC.

Eplan: Eplan is the software used at Supfina Machine for schematics. Supfina provided us with a variety of resources to help us learn to navigate and the software to be able to modify the schematics. Some of the resources included the "EPLAN electric P8 Reference Handbook", the beginners guide to eplan, and videos to follow along with the instructor. Eplan is a helpful software as it is similar to ladder logic which is what operators are familiar with to create the designed machines. The use of this software to create, and modify schematics helps increase the communication between engineers and manufacturers which inturn decreases the likelihood of mistakes. **(Figure 2)**

Hardware Design/Schematic Update: With guidance and help from our technical director the schematics were updated to include the new sensors and the connections necessary to provide power to the components, and communication between the sensors and the IO-link master, the master and the PLC, and the PLC to the eWON Flexy modem. **(Figure 3)**

Hardware Implementation: With help and direction from our technical director and the schematics, the sensors were connected using the appropriate wire gauge, and identifying the correct terminal blocks in the existing electrical cabinet. Along the process of connecting the sensors to their appropriate terminal block, there was a modification to the power supply that powered the power meter. We identified that there were two 24V DC supplies, one that was directly connected to the 480V supply, and another was derived from a 115V transformer that was connected to the 480V supply. On the schematic diagram we originally had the power meter being supplied from the 24V supply from the 115V transformer but decided to change it to the 24V power supply that was directly connected to the 480V supply. In addition, we had originally chosen a 5A circuit breaker for the power meter, but decided to use a 1A circuit breaker because the power meter datasheet suggested the 1A. **(Figure 4)**

Software Tools: The computer engineering members of our team **learned to use Java and the Eclipse IDE on a fundamental level.** We downloaded packages that allowed functionality with Amazon Web Services, and ran tests on Supfina's DynamoDB test code. The purpose of Eclipse was for HTML web development.

Introduction to PLC: Learning PLC was one of the crucial parts of the project. Being able to program in PLC allows the team to retrieve data from the sensors. Once the sensors are fully integrated into the machine, we will be able instruct our sensors with PLC Programming.

Web Development: To be able to access data effortlessly, a website was needed. Our computer engineers **learned web development concepts.** In addition to learning HTML and CSS, we learned more about the best practices for web development such as using the inspect tool to learn from existing websites and we were able to create a website.

Programmed scripts to process machine data: For the web server to function properly, the HTML required javascripts to manipulate data. The scripts will be used to display data sent from the machine. This was created to encourage consumers to better machine supervision, in case of malfunctions due to improper usage. The web server displays a data table along with a graphical representation. It also provides links to contact the company and their services.**(Figure 1)**

Java Programming with AWS: In order to be able to display data on the web server, the backend needs to be created. The program was created using Java. This allows us to access and obtain data being stored in the AWS database. Afterwards the data received is formatted as a .JSON and is sent to the web server to be presented in a table or graph.

Anticipated Best Outcome

The project's anticipated best outcome will be creating a functioning IIoT data collection system on existing Supfina machines in addition to a web-based system to display, organize and analyze process data which will allow Supfina to adjust, modify, and improve their machines.

Project Outcome

The Anticipated Best Outcome was not achieved

Figures

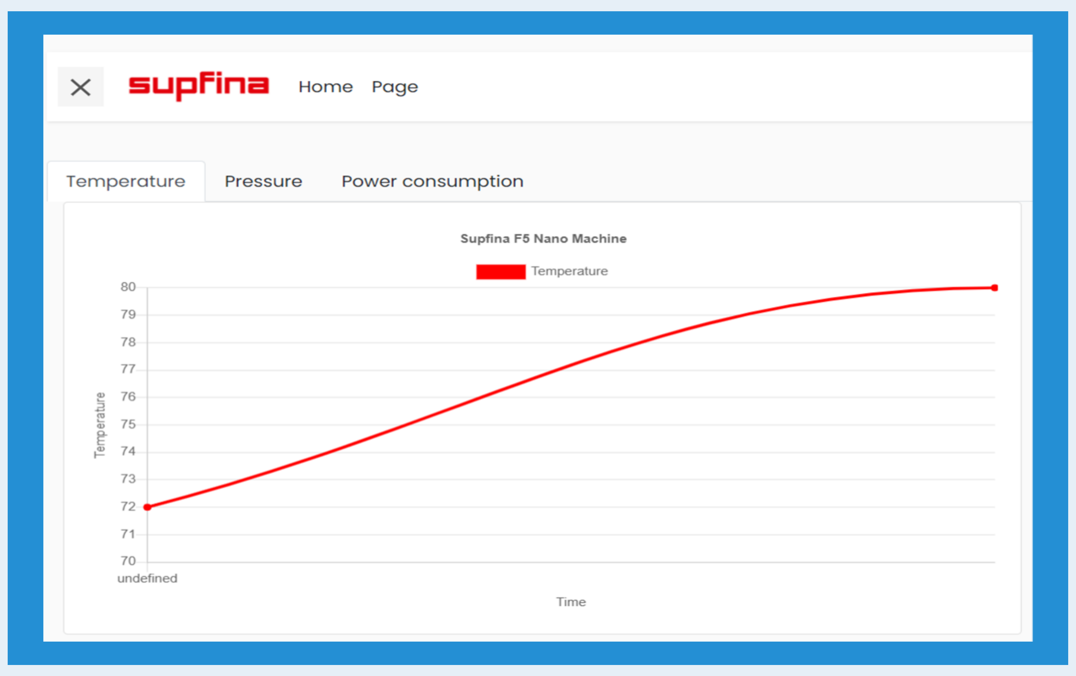


Figure (1): Temperature Graph

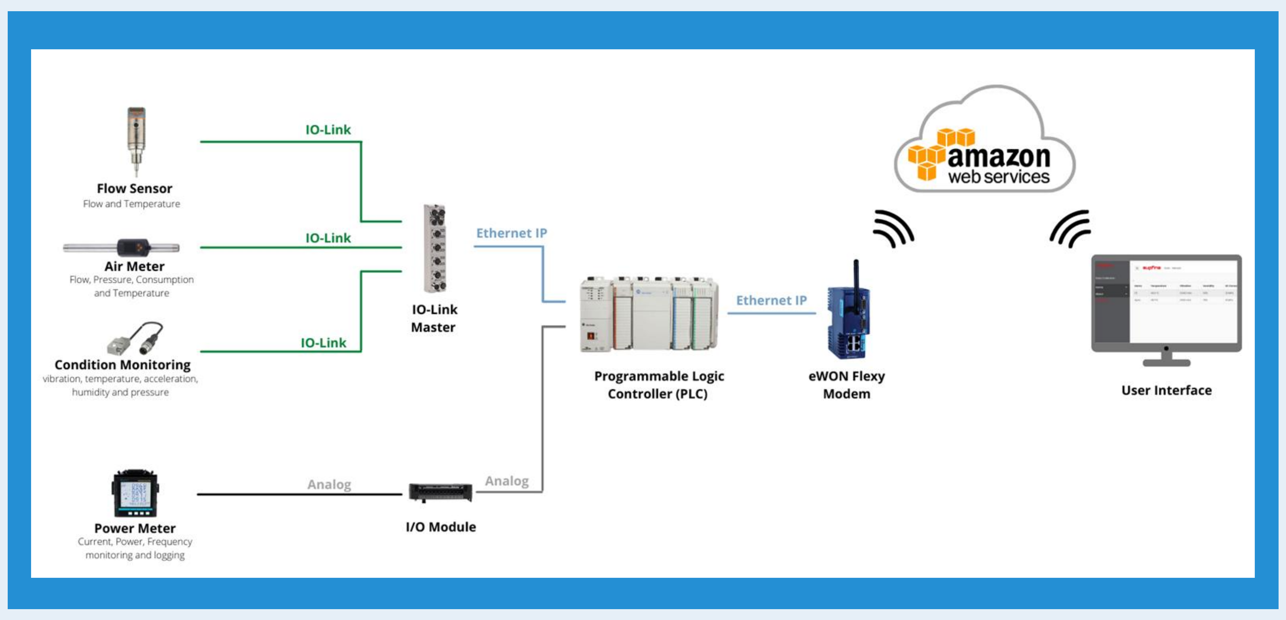
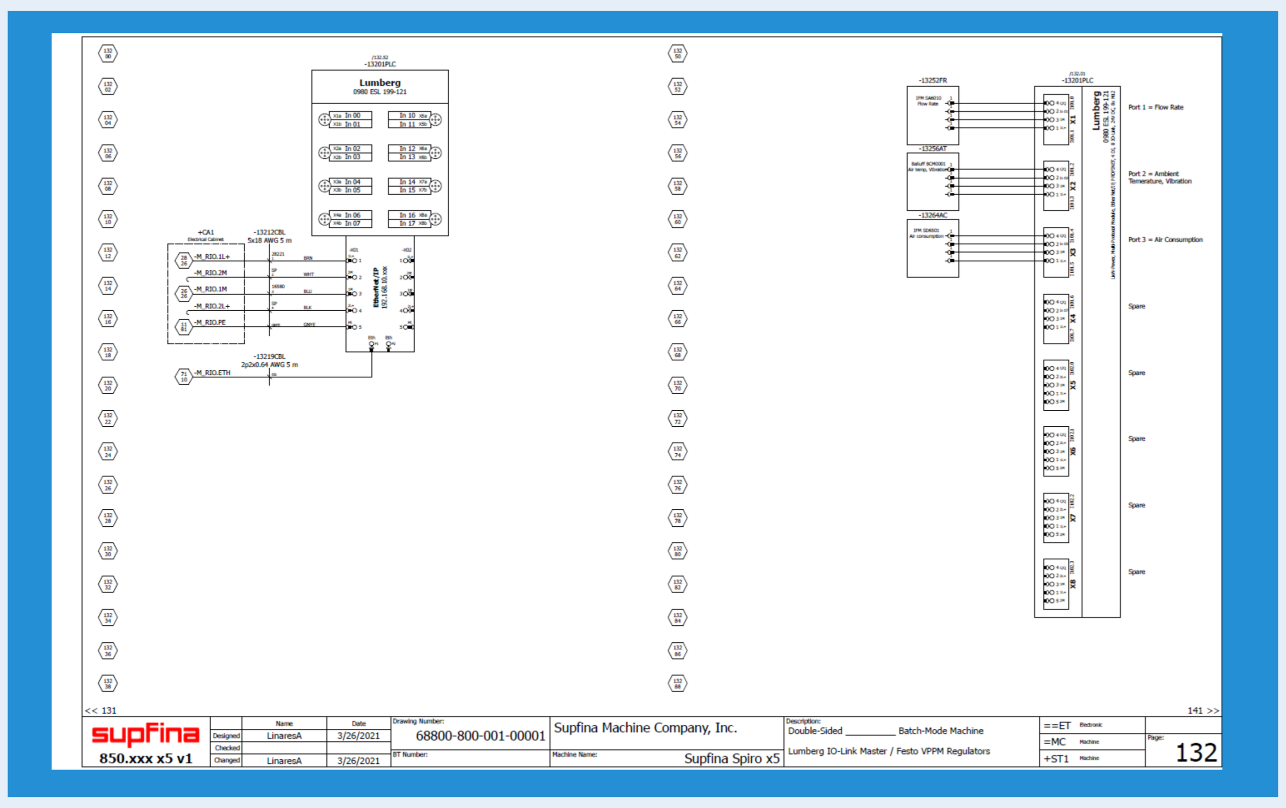


Figure (2): Block Diagram



Figure(3): Schematics

Figure(4): (L) Spiro F5 Machine (R) Nano Machine