



Project Superfinish

Full-Production Superfinishing Machine
ELECOMP Capstone Design Project 2018-2019

Sponsoring Company

Supfina Machine Company, Inc.

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Company Overview

Supfina Machine Company is one of the largest suppliers of abrasive finishing machines and attachments. Our company improves the surface geometry of parts using an abrasive media. Areas of focus typically are automotive parts and bearings such as: camshafts, crankshafts, drive shafts, fuel injectors, transmission components, inner and outer races, roller bearings, etc. Our US Technology Center is located in North Kingstown, Rhode Island, where sales, engineering, manufacturing, assembly, research and development, and customer service functions are all performed.

Technical Directors

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Project Motivation

In the industrial world, manufacturing plants are becoming more and more automated, which helps to generate consistent results. Supfina machines achieve surface finishes with tolerance in the micron scale within a short period of time.

Supfina currently has the Nano; a single cup-wheel lab machine. It has generated much interest over the years and is used for contract work and testing; uniformly achieving the results that Supfina expects. Because of its small footprint, the machine's capabilities are almost limitless. That said, the Nano can only superfinish workpieces with a maximum diameter of approximately 150 mm and a maximum cup-wheel diameter of 60 mm.

The SM-814-S1 superfinishing machine is the Nano's "big brother." The SM-814-S1 allows workpiece diameters of 270 mm or more and can be used with a maximum cup-wheel diameter of 150 mm. Having this machine in our facility will allow us to do contract work for customers and, more important, persuade them to buy the SM-814-S1.

Starting with a blank slate, this project intends to develop ideas and concepts; to create the necessary blueprints and schematics to realize those designs; and to finally to build a user-friendly, reliable machine that exceeds all of the customer's manufacturing expectations.

Anticipated Best Outcome

The goal is to successfully design and implement an electrical system and machine program to produce a fully functional Supfina SM-814-S1 superfinishing machine within the allotted time and budget. The machine should operate in a safe and fully functional manner as well as be able to run a wide variety of parts.

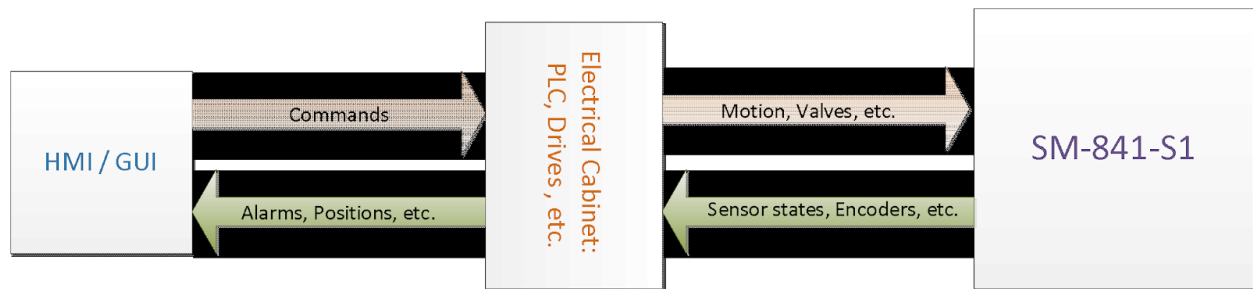


Project Details

In order to meet the requirements of the project, the team will work closely with the the Supfina mechanical engineering team in order to learn the machine's other features. Mechanical engineers design the tooling, machine footprint, and fluid mechanics (rinse, pneumatics). They also specify motors.

The electrical engineer must add the appropriate hardware to turn on various pumps and motors; provide feedback with sensors; engage solenoids; specify servo drives; and determine all of the necessary wiring. The electrical engineer also prepares layout prints so that electricians can properly assemble the electrical panel.

The computer engineer takes all of the electrical components and gives the machine a heartbeat. The computer engineer relays all of the signals coming into and out of the PLC (programmable logic controller) inputs and outputs; programs servo-drive motion; and generates fault messages and various sequences for the machine operation. The computer engineer works with application engineers and incorporates their specifications on positions, rotational speeds, cycle times, and additional process parameters. The computer engineer also creates HMI (human machine interface) screens so that the operator can properly run the machine.



Block diagram of electrical controls.



Hardware Tasks:

- Create electrical schematics that include the necessary hardware for motion control, I/O, and safety
- Design panel layout with dimensions for assembly
- Create accurate BOM that meet budget requirements
- Troubleshoot electrical wiring
- Machine debugging

Software Tasks:

- Create flow chart to outline sequences
- Design and develop PLC firmware using ladder logic based on schematics and project requirements
- Generate user-interface screens for touch panel
- Machine debugging

Team Composition

One electrical engineer and one computer engineer

Skills Required

Electrical Engineering:

- Understand PID loops
- Understand power systems/distribution
- Read and interpret electrical schematics
- Analog and digital circuit theory and analysis

Computer Engineering:

- Windows application GUI development (XAML/Windows Forms/WPF)
- Possess strong documentation skills (JavaDoc Style Comments and UML Diagrams)
- Know object-oriented /low-level programming (ladder logic)
- Knowledge of Boolean Logic
- Know basic electrical principles



Anticipated Best Outcome's Impact on Company's Business and Economic Impact.

Supfina will be able to create an SM-814-S1 superfinishing machine for our process research and development lab, allowing us to test applications and perform contract work for customers. It also will provide a "floor model" for persuading customers to buy the machine. Building this machine would save us \$100k+ and potentially transform those savings into additional revenue.

Broader Implications of the Best Outcome on the Company's Industry

This will enhance Supfina's surface-finishing product line. The 814 would give us a platform to further research, develop, and perfect cup-wheel finishing to achieve better surface finishes, specifically flatness.