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Electronic Upgradation of RCB Machine with PLC Controls

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Abstract - *Automation is defined as a technique of making an apparatus, a process, or a system operate automatically i.e it is the set of technologies which reduces human interference and provides better performance. The goal of this paper is to discuss about the up-gradation of the RCB Machine which aims at reducing the downtime and thereby increasing the efficiency which in turn helps in improving the production. The present CNC system is converted into PLC system.*

Key Words: **RCB Machine, Grinding, CNC System, PLC System, Siemens S7300, CPU 314C-2 DP, Mitsubishi VFD.**

1. INTRODUCTION

The aim of SKF India LTD. is to supply product of high quality in the market for maintaining the market requirements. To achieve this goal, it is needed that the machinery should be up to date. The present Roller Grinding Machine uses an obsolete CNC system, [4] which is very complicated and not up to date. If during the working of the machine, the system fails, there is a stale in the production which degrades the position of the company in the market.

Thus to meet the quality and timely requirements of the growing society, the company has decided to upgrade the machine with Siemens PLC Controls. [5] The new PLC which will be used has integrated parts, and also reduces need of spare parts.

1.1 Grinding and RCB Machine

Grinding is a process by which excess material is removed using a silica grinding tool by continuously rubbing the inner surface of the product with the tool. Grinding is used to finish work pieces that mush show high surface and high accuracy of shape and dimension. The grinding machine uses an abrasive wheel on a cutting tool.

The RCB Machine is machine in the roller manufacturing line. The machine uses the grinding process to remove about 250 – 300 µ of excess material. The specifications of the RCB Machine are as follows:

1. R – Machines for Roller Manufacturing.
2. C – Taper Roller OD Grinders.
3. RCB40B – Inclined Drum Machines.

1.2 Disadvantages of present CNC System

The machine is operating on Siemens 810G CNC which has become obsolete now.

1. Also it has high down time and thus efficiency reduces.
2. The CNC system can only perform one task at a time.
3. The system is also not up to date with the latest technology trending in the market, which will affect the quality of the product and to meet the market requirements which affects the position of company.

By using Siemens S7300 PLC, the following advantages can be achieved:

1. High Productivity and Efficiency.
2. Ease of operation.
3. Multiple function controlling.
4. Reduced machine downtime and higher safety.

2. BLOCK DIAGRAM

The RCB Machine when up-graded will work on Siemens S7300 CPU 314C-2 DP PLC in accordance with the below shown block diagram.

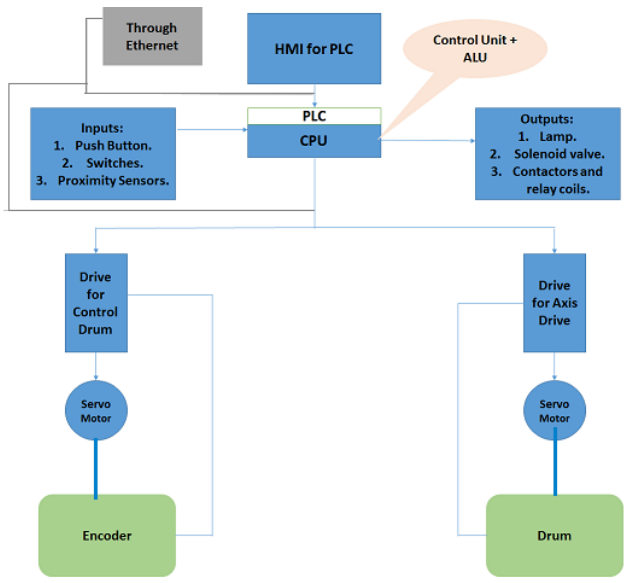

Figure -1: Block Diagram of PLC System in RCB Machine

2.1 Siemens S7300 CPU 314C-2 DP PLC

A Programmable Logic Controller is a specialized computer. Since it is a computer, it has all the basic component parts that any computer has; a Central Processing Unit, Memory, Input Interfacing and Output Interfacing.

The CPU used with the Siemens Simatic S7300 PLC is 314C-2 DP Compact CPU. The CPU comes with an inbuilt Multi Point Interface. [5]

The features of this CPU are:

1. 24 Digital Inputs.
2. 16 Digital Outputs.
3. 5 Analog Inputs with 2 Analog Outputs.
4. Integrated RAM upto 192KB.
5. ROM: 64KB.
6. Execution Time (bit instructions): 60nsec.
7. Data blocks: 1024.
8. Interface Power Supply: 24V DC.
9. Interface: RS232 and RS485.
10. Transmission Rate: upto 12Mbps.

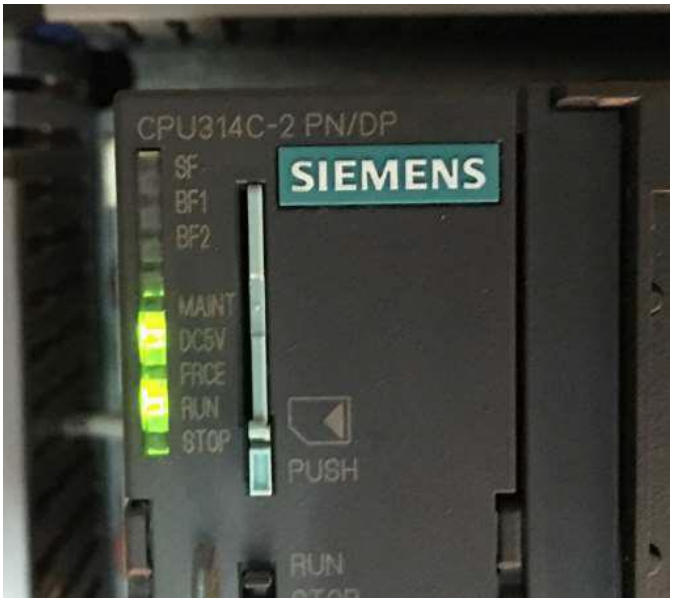

Figure -2: Siemens CPU

2.2 Digital I/O

1. Digital Inputs: Digital inputs include float sensors, selector switch, pressure switch, push buttons, limit switches, level switches, capacitive proximity sensors, toggle switch.

2. Digital Outputs: Digital outputs include the solenoid valve, contactor and relay coils, indication lamp, motor, drivers.

2.3 Siemens Multi Touch Panel HMI

The Human Machine Interface (HMI) includes the electronics required to signal and control the state of industrial automation equipment. The interface panel used is Siemens Multi Touch Panel.

Figure -3: Siemens Multi Touch Panel

2.4 Analog Servo Drive

The driving system for the Servo Motor is Siemens Analog Servo Drive Simodrive 611. The basic block diagram is as shown:

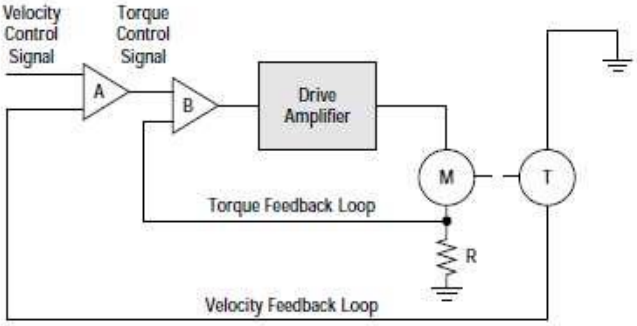

Figure -4: Analog Servo Drive

The features of Simodrive 611 are:

1. 4 digital inputs and 4 digital outputs per drive.
2. Serial Interface: RS232, RS485.
3. Angular Incremental Encoder Interface.
4. Operation Modes: Speed Control, Open Loop Torque Control.
5. 2 axis for encoders.

The total number of pulses required to move the designated distance is obtained using the equation:

$$\left(\text{Total No. of pulses required to move designated distance}\right) = \frac{\left(\text{Designated distance}\right)}{\left(\text{Machine (load) side moving distance for each motor rotation}\right)} \times \left(\text{No. of pulses required for motor to rotate once}\right)$$

2.5 Variable Frequency Drive

A Variable Frequency Drive (VFD) is a power conversion device. It converts a basic fixed frequency, fixed voltage sine-wave power (line power) to a variable frequency, variable-voltage output used to control speed of induction motors.

The VFD used for our project is Mitsubishi A700 VFD with the following features:

1. The control terminals are M0-M5 and a GND Terminal.
2. There are 3 relay feedback terminals – RA, RB, RC.
3. AFM stands for Analog Frequency Meter which is used for frequency feedback. The range of the AFM is 0-10V; 0-50Hz. Also an Analog Voltage Input (AVI) is present.

The VFD Interconnections are shown below:

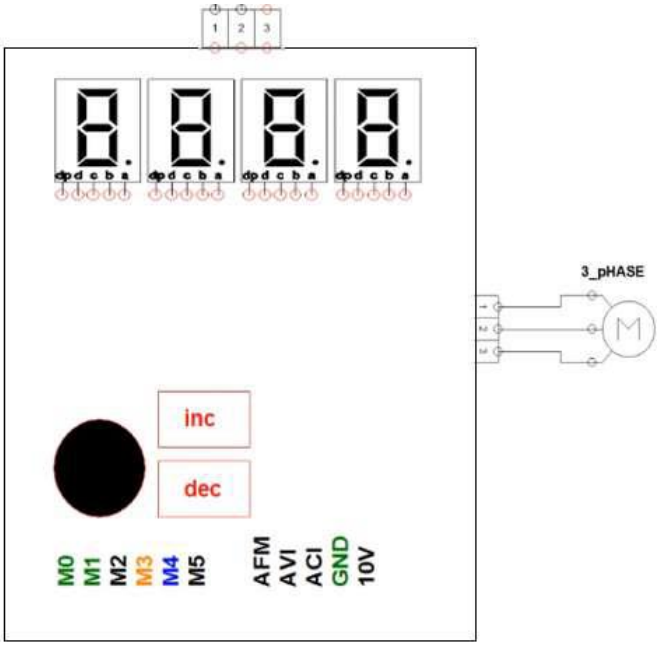

Figure -5: VFD Interconnections.

The frequency range to be set on the VFD is from 0Hz- 70Hz.

3. ELECTRICAL WIRING DIAGRAMS

The electrical wiring diagrams are used to represent the interconnections in the PLC.

1. VFD Wiring:

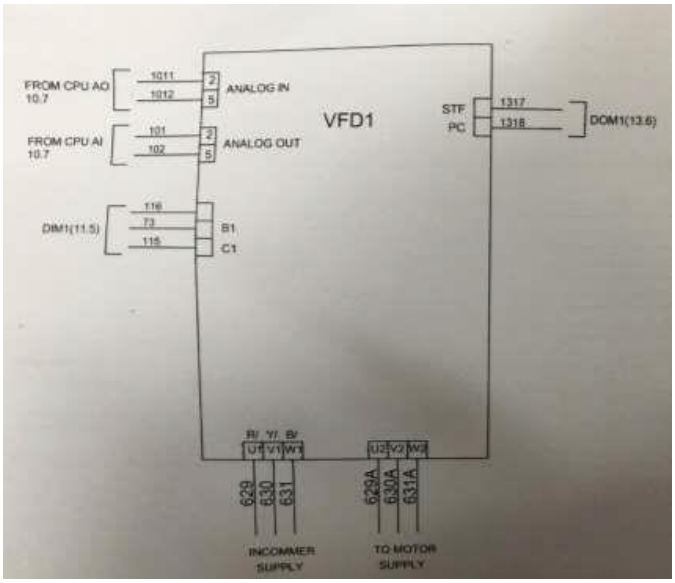

Figure -6: VFD Wiring.

2. Motor Wiring:

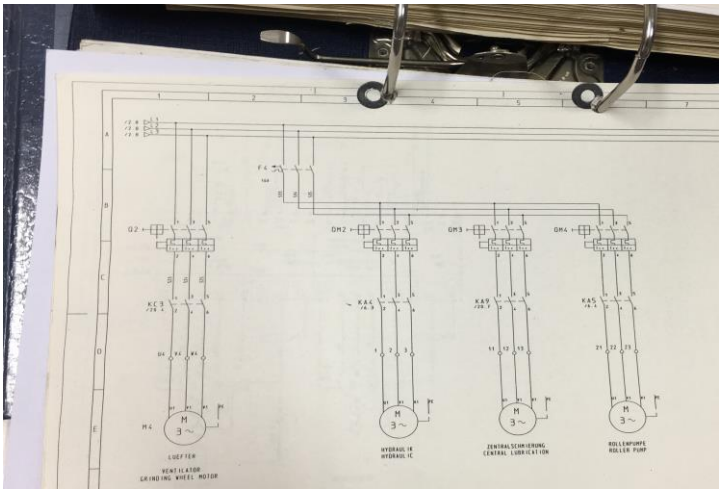

Figure -7: Motor Wiring.

4. SOFTWARE IMPLEMENTATION

The software used to program Siemens S7300 PLC is STEP 7. It is a paid software which has the following features:

1. i5 core 2.4Ghz processor.
2. RAM: 3 GB (32 bit); 8 GB (64 bit).

3. Graphics 1280*1024
4. Integrated Security Systems.
5. 6 selectable user interface languages.

The algorithm made on basis of the machine operation is divided into three phases:

1. Machine Startup Cycle.
2. Machine Reference Cycle.
3. Machine Setting Cycle.

1. Machine Startup Cycle:

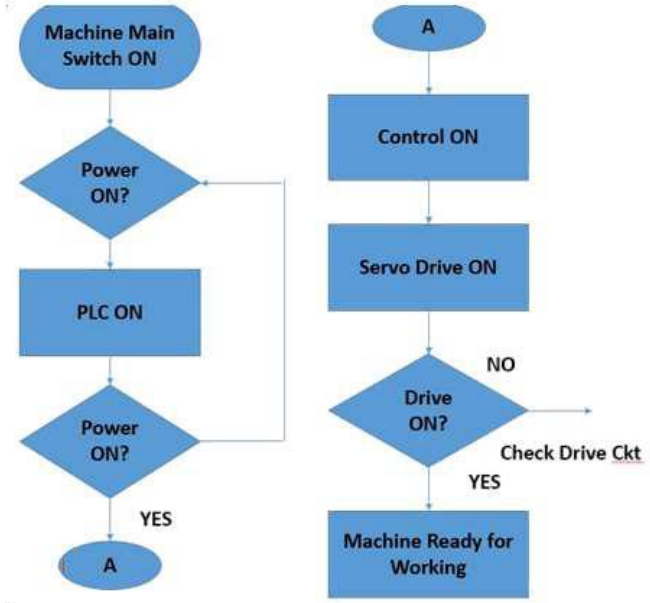

Figure -8: Machine Startup Cycle.

2. Machine Reference Cycle:

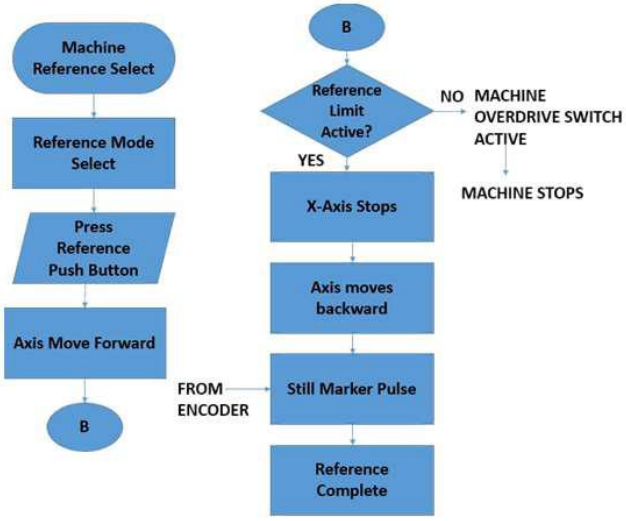

Figure -9: Machine Reference Cycle.

3. Machine Setting Cycle:

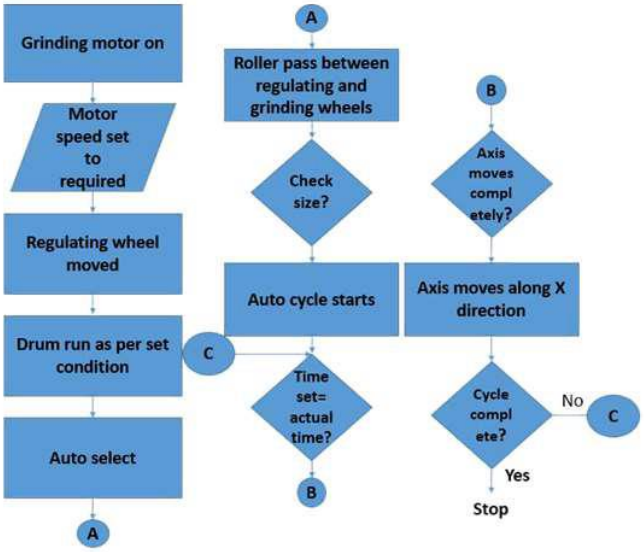

Figure -10: Machine Setting Cycle.

5. RESULTS AND DISCUSSION

The upgraded PLC system has the following parameters:

1. Efficiency: Changed from 57.90% to 61.80%.
2. Downtime: Reduced from 10% to 4%.
3. Stoppages: Reduced from 65 to 4.

The basic reasons for using PLC System:

1. Reduced Space:

PLC is a solid state device and hence extremely compact as compared to hard wired controller.

2. Energy Saving:

Power required by PLC is less as compared to the equivalent relay logic board.

3. Re-Programmability:

PLC can be easily re-worked upon.

4. Reduced Downtime:

The downtime for the machine using PLC is considerably reduced when compared to the CNC using RCB Machine.

5. Greater Reliability and Lifetime:

PLC consists of static devices; hence less number of parts reduces wear and tear and hence less downtime of the machine.

6. FUTURE SCOPE

Under this project, we up graded the RCB Machine with S7300 PLC. We can add more features within control unit of RCB which will provide safety, flexibility and scalability.

In future we have ideas about such features which can be included in RCB machine, like to add cleaning alarms in control unit by using Real Time Registers which can be programmed using Ladder diagram. Also networking between different Machines can be done to control them by sitting at a single place and thereby reducing the need of operators at each and every machine. We can use different wireless communication modes and protocols to have such communication among PLCs of different machines which works as a main controlling unit for bearing production in SKF India Ltd.

7. CONCLUSION

PLC provides a robust modular platform for automating complex machines and processes. The SIEMENS PLC, being from one of the leading automation companies, offers high performance, flexibility and advanced feature. Scanning time and maintenance time of the system is thus reduced by using PLC; thus leading to progress in production of bearings.
The compactness required in the system is achieved by upgrading the grinding machine with the SIEMENS PLC. Also the cycle time is reduced.
Also, the selection of SIEMENS PLC was done because of its ease of operation with the workers.
Hence, performance and efficiency of the system is improved.

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REFERENCES

[1] Hui-Cun Shen and Kun-Chieh Wang, "Exploring the Optimal Structure of a CNC Grinding Machine"
[2] Jianhua Zheng, Rong Zhu, MingLiang Jiang, "Model Integration Framework for Computer Numeric Control System Design"
[3] Jianhua Zheng, Di Li and Zhaogan Shu, "New Approach for Embedded Computer Numeric Control Development", the 9th International Conference for Young Computer Scientists.
[4] CNC 810G Manual.
[5] Siemens S7300 Manual.
[6] CPU 31xC Manual.
[7] Siemens Multi Touch Panel HMI Manual.
[8] Simodrive 611 Manual.
[9] Mitsubishi VFD A700.
[10] SMPS DRP-240-24
[11] www.skfindia.com
[12] http://w3.siemens.com/mcms/programmable-logic-controller/en/advanced-controller/s7-300/pages/default.aspx