Automation And Productivity Improvement Of Mechanical Milling Machine

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Abstract- *A programmable logic controller, PLC or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery in factory.*

Milling machines were first invented and developed by Eli Whitney to mass produce interchangeable musket parts. Although crude, these machines assisted man in maintaining and accuracy and uniformity while duplicating parts that could not be manufactured with the use of a file. Development and improvements of the milling Machines and components continued, which resulted in the manufacturing of heavier arbours and high speed steel and carbide cutters. These components allowed the operator to remove metal faster and with more accuracy than the previous Machines.

Variations of milling machines were also developed to perform special milling operations. During this era computerized machines have been developed to alleviate errors and provide better quality in finished products.

Keywords- Milling machine,PLC,SMPS module,Power supply,Servo drive ,Limit switch,Relay

I. INTRODUCTION

The Milling process removes material by performing many separate small cuts. This is accomplish by using a cutter with many teeth, spinning the cutter at high speed, or advancing the material through the cutter slowly; most often it is some combination of this three approaches. It is one of the most commonly used processes in industry, but this milling machines needs man power to perform the operations which takes more time.

In our approach we are using PLC to operate the milling machine automatically so it is time consuming and there is no need of man power to carry out the operations. In milling machine instead of lead screw we are going to use ball screw. A ball screw uses recirculating ball bearings to minimize friction and maximize efficiency. Ball screw are more efficient, requiring less torque also ball screw have lower friction than lead screw and it run at cooler temperatures.

A programmable logic controller, PLC or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory. Milling machines were first invented and developed by Eli Whitney to mass produce interchangeable musket parts. Although crude, these machines assisted man in maintaining and accuracy and uniformity while duplicating parts that could not be manufactured with the use of a file. Development and improvements of the milling Machines and components continued, which resulted in the manufacturing of heavier arbours and high speed steel and carbide cutters. These components allowed the operator to remove metal faster and with more accuracy than the previous Machines.

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II. LITERATURE SURVEY

[1]"International Journal of Machine Tools & Manufacture 45: Expert Spindle Design System."

Osamu Maeda, Yuzhong Cao, Yusuf Altintas Manufacturing Automation Laboratory, Department of Mechanical Engineering, University of British Columbia, 5 October 2004.

This paper presents a general, integrated model of the spindle bearing and machine tool system, consisting of a rotating shaft, tool holder, angular contact ball bearings, housing and the machine tool mounting. The models allows virtual cutting of a work material with the numerical model of the spindle during the design stage. The proposed model predicts bearing stiffness, mode shapes, frequency response function, static and dynamic deflections along the cutter and spindle shafts, as well as contact forces on the bearings with simulated cutting force before physically building and testing spindles. The proposed models are verified experimentally by conducting comprehensive tests on an instrumented industrial spindle. The study shows that the accuracy of predicting the

performance of the spindles require integrated modelling of all the spindle elements and mounting on the machine tool. The operating conditions of the spindle, such as bearing preload, spindle speeds, cutting conditions and work material properties affect the frequency and amplitude of vibration during machining.

[2] "International Journal of Computer Applications Programmable Logic Controllers."

Richa Netto, Aditya Bigari Thadomal Shahani Engineering College, Mumbai University Bandra, Mumbai-400050 Maharashtra, India September 2013.

The analysis carried out in this technical paper highlights the concepts, working, advantages and practical applications of PLC's along with comparisons with other control systems.

A PLC aids in automation of a process by monitoring inputs and controlling outputs after making a decision on the basis of its program. It is commonly used for controlling many mechanical moments of heavy machinery and to control the voltage and frequency of power supplies. PLCs offer an array of advantages over other control systems, and have hence evolved as an important controller in industries these days owing to its large number of application.

[3] "International Journal of Digital Application and Contemporary Research: Review of Automated Profile Cutting Machine Using PLC."

Satya Kumar Behra Instrumentation & Control Engineering and Amar Kumar Dey Electronics and Telecommunication Engineering, Bhilai Institute of Technology, Durg, India, volume 3,issue10,May 2015.

Global competitions and technological advances are forcing manufacturers, designers and engineers to constantly innovate new product manufacturing strategies in reducing product development cost and time. Contemporary manufacturers have the option of selecting optimum technologies to suit their manufacturing environment. CNC is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alpha numeric data. This technique is basically used for industrial application. These paper presents that how to work profile cutting machine by using PLC technique.

[4] "International Journal of Electronic Engineering and Computer Science: Development New Press Machine Using PLC."

N.M.Z. Hashim, N.M.T. Ibrahim, Z. Zakaria, Fadhli Syahrial, H. Bakri Faculty of Electronics and Computer Engineering University Technical Malaysia Melaka, volume 2 issue 8 August 2013.

The press machine is a project that is designing a new way to improve the previous press machines in industries which has a few weaknesses in safety while operating processes. This will create a lot of problem to the operators which have the higher risk to have an accident. The new press machine is a project to improve previous press machine which have weakens in safety while operating it. It consists of five pneumatic cylinders which each cylinder have their own function. This project contains two states of operations which in automatic and manual mode.

III. PROPOSED SYSTEM

PLC is used for automation purpose. Limit switch is used for controlling machinery as a part of control system and to counts object passing a point. We use power supply of 230VAC single phase and 415VAC three phase. SMPS transfers power from a DC or AC source to DC loads. At load circuit that consumes electric power. Relay is used as a switch. Servo drive monitors the feedback signal from the servomechanism and continually adjusts for deviation from expected behaviour.

Block Diagram

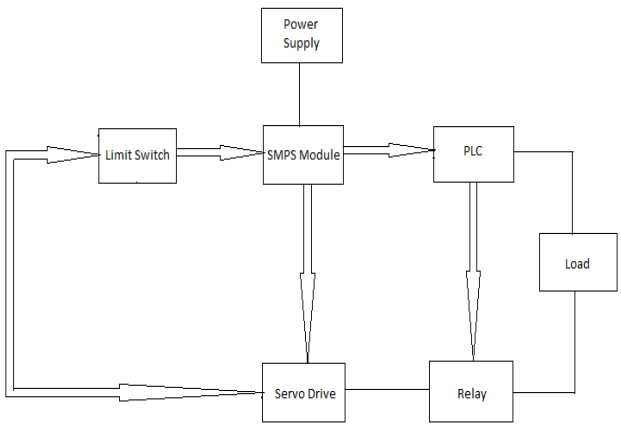

Fig:System block diagram

Block Diagram Explanation

Limit Switch:

A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator the device operates the contacts to make or break an electrical connection. Limit switches are used in variety of applications and environments because of their ruggedness, ease of installation and reliability of operation. They can determine the presence or absence, passing, positioning and end of travel of an object. They were first used to define the limit of travel of an object hence the name limit switch.

Rarely final operating device such as lamp will be directly controlled by the contacts of an industrial. But typically limit switch will be wired through a control relay, a motor contactor control circuit and as an input to PLC.

PLC:

A Programmable logic controller is a digital computer used for automation of typically industrial electromechanical processes**,** such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLC's are used in many machines, in many industries. PLC's are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise and resistance to vibrations and impact. Programs to control machine operation are typically stored in battery-backed-up on non-volatile memory. A PLC is a example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result. The automotive industry is still one of the largest users of PLC's. Early PLC's were designed to replace relay logic systems. These PLC's were programmed in ladder logic.

Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was mainly composed of relays, cam timers, drum sequencers and dedicated closed loop controllers. Since these could number in the hundreds or even thousands, the process for updating such facilities for the yearly model changeover was very time consuming and expensive, as electricians needed to individually rewire the relays to their operational characteristics.

Advantages of PLC:

- Flexible
- Faster response time
- Modular design ,easy to repair and expand
- Handles much more complications.

Relay:

A relay is an electrically operated switch, used where it is necessary to control a circuit by a low power signal or where several circuits must be controlled by one signal.

SMPS:

It is a switch mode power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from resource, like a main power to load such as a personal computer, while converting voltage and current characteristics. SMPS have applications in various areas. Switched mode supply is chosen for an application when its weight, efficiency, size or wide input range tolerance make it preferable to linear power supply.

Servo Drive:

A servo drive receives command signal from a control system, amplifies the signal, and transmits electric current to a servo motor in order to produce motion proportional to command signal. Servo systems can be used in factory automation, among other uses. Their main advantage over traditional AC or DC motors is the addition of motor feedback. This feedback can be used to detect unwanted motion or to ensure the accuracy of commanded motion. The feedback is generally provided by an encoder of some sort. Servos, in constant speed changing use, have a better life cycle than typical ac wound motors. Servo motors can also act as a break by shunting off generated electricity from the motor itself.

Load:

An electrical load is a portion of a circuit that consumes electric power. It affects the performance of the circuits with respective output voltage or current such as sensors, voltage sources and amplifiers.

Spindle:

The spindle holds and drives the various cutting tools. It is shaft, mounted on bearings supported by the column. Spindle is driven by an electric motor through a train of gears, all mounted within the column. The front end of the

spindle, which is near the table, has an internal taper machined on it.

Power supply:

Power supply is an electronic device that supplies electric energy to an electrical load. The primary function of power supply is to convert one form of electrical energy to another. Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source. All power supplies have a power input, which receives energy from the energy source, and power output that delivers energy to load.

Milling Machine:

Milling machines were first invented and developed by Eli Whitney. Variations of milling machine were also developed to perform special milling operations. Milling is a cutting process that uses a milling cutter to remove material from the surface of a work piece. The milling cutter is a rotary cutting tool, often with multiple cutting points. The milling process removes material by performing many separate, small cuts. In our approach we are using PLC to operate the milling machine automatically so it is time consuming and there is no need of man power to carry out the operations. In milling machine instead of lead screw we are going to use ball screw. A ball screw uses recirculation ball bearings to minimise friction and maximise efficiency. Ball screw are more efficient, requiring less torque also ball screw have lower friction than lead screw and it run at cooler temperatures.

IV. ADVANTAGES AND APPLICATIONS

Advantages

1. Very accurate and simple structure.
2. Human safety.
3. Time consumption.
4. More secure.
5. Production cost increases.
6. Efficiency is 100%.

Applications

1. Easy to produce product, so market value increases.
2. Automatic work will be done so manpower requirement is less.
3. Machine value is greater.

V. CONCLUSION

In this paper,we discuss about milling machine operations with help of PLC. We know that there are many functions can be done with the help of PLC as using PLC machine works are very fast and time consuming as compared to manual work. In addition,if giving other some input data as as reference then accuracy of results also increases as compared to other methods.

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