# Design and Development of a Data Log for Automatic Industrial Paper Roller Grinding Operation Machine

Rakesh Kumar Gupta[1]
Prashant Mani Shukla[2], Prarthana Vaish[3], Yash Verma[4], Raushan Kumar[5]

Student of Electronic and Communication Engineering[2, 3, 4, 5]
***ABES Engineering College, Ghaziabad, Uttar Pradesh, India***
rakeshgupta@abes.ac.in[1]

**Abstract**
**This paper present a modernized a paper roller grinding machine to increased work efficiency of operator in term of time. Controlling and monitoring system of grinders for implementation in the industries with the objective to achieve more safe and economic conditions. This system works with a firmware so as to get a prolonged equipment life achieved through reduced mechanical stress, high efficiency, energy saving and highest possible performance levels along with speed controls. The entire system will be based on monitoring current consumed by the grinding motor as it is the efficiency of grinding that determines the time taken for the job to get completed. Based on client interactions, the major operations to be considered and the corresponding permitted range for the current flowing through grinding motor are as mentioned Grinding: 17 A – 20 A, Matching: 10 A – 12 A , Finishing: 08 A – 10 A.**

**Keywords**: Microcontroller, Paper Roller, USB Data log, VFD, Induction Motor, Current Sensor

## I. INTRODUCTION

In modern manufacturing industries, electric motors drive all mechanical and electromechanical systems on the premises. The use of induction motors is a suitable option for the purpose of industrial grinding operations due to their reliability and brushless design.

The electrical parameters of the motor have a crucial role in performance of the motor. That is the reason why high performance AC motor control methods are very sensitive to motor parameters. For a drive system, all electrical and non-electrical parameters like frequency, current, voltage, temperature, and speed of the induction motors are very important parameters. Whole fundamental qualities directly affect the performance of an induction motors. Change in any parameter of induction motor causes the quality of product to change, thus controlling the machines during the process of production is definitely a dangerous operation in most of industry because the changes made to material to be processed are often irreversible.

In the industrial over 50% of the total electric energy generated is consumed by motor driven systems. The induction motors are widely applied due to their low price and ruggedness. Recently, the energy issue has resulted in an increased interest in the motor efficiency. Many energy reports have claimed large savings in energy usage if high efficiency motors are universally used. There may be various reasons for the desire of testing an existing induction motor in the field, such as consideration of exchanging out of date or worn motors. There are several methods relevant to field efficiency evaluation in the literature and new methods are appearing every year. One proposed method [1-3] is the nonintrusive method that can help the plants to make the right decision in replacing the inefficient motors with new more efficient ones. This method has proposed the estimating efficiency of actual motors without the need to disconnect the motors from the process and without the need to measure the output power. The required field test data which rely on measuring the input voltage, current, electrical power, and output speed of the motor are obtained from the measurement at any load.

VFD is variable frequency drive. VFD used to control the speed of electric induction motor. Induction motors are fixed speed motors which are used in most industries because of its reduced cost, reliability and rugged nature. The speed of the induction motor can be changed by various methods such as poles changing, voltage changing, connecting the resistance in rotor circuit etc., but the most efficient method is changing the supply frequency and voltage to the motor. Speed is directly proportional to the frequency of supply. The variable frequency drive (VFD) varies the frequency and hence varies the speed or torque of the induction motor as per the requirements of the load [4].

Grinding is a very complex material removal operation. Compared to conventional machining, grinding differs in many ways, including the use of high wheel speeds, fine depths of cut, a large number of multiple cutting points of unknown geometry which varies continuously with time, the high negative rake angles presented by the abrasive grains. As a simplified model of the grinding, the grinding technique with a single abrasive grain is an effective way to explore the mechanism of the complex grinding. Komanduri[5] investigated machining with high negative rake angles to simulate grinding and made an attempt to provide an alternate explanation for some of the anomalies, such as the force ratio, specific energy, subsurface deformation by comparing grinding with machining with high negative rake angle tools.

The aim of this paper is to redesign and automate the traditional system of industrial paper roller grinding machine. This helps improve the efficiency of the running system by monitoring. This paper proposed a model to automatic the grinding machine with help of measurement of the current parameter of the grinding induction motor through the help of current sensor. Current data varies based on torque apply to roller to grinder vice versa. Data is feed to Microcontroller to calculate and take action.

To help of Microcontroller Induction motor parameters have been used to display the electrical and mechanical performance by using a Human Machine Interface(HMI).Also the parameters of the grinder motor are controlled through the HMI, such as the on/off operations and speed controls. Also the current parameter of the motor is closely monitored in order to determine whether the grinder motor is simply running free(without any load) or an actual load is attached i.e., grinding operation is being performed. The paper contain the section wise valuation part to automate the grinding machine first section describe Introduction part, second part is proposed work, next Working and Results and then forth one in conclusion part cover in this paper.

## II. PROPOSED WORK

In this paper, the hardware was designed with the Atmega 2560 microcontroller and USB data log .The microcontroller is an 8-bit microcontroller based on AVR RISC architecture. It has 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface and 16 channel 10-bit ADC. The central software was developed with C language to read motor parameters, apply mathematical models of prediction and present statistics. The HMI interfaced in the design is Delta DOP-07 series industrial grade HMI. Details of the designed Automation of induction motor monitoring hardware and monitoring system software are described below. Figure 1 represent the proposed block diagram of the problem solution. Here in this paper, the quality of product might refer to finish, thickness/radius of raw material being processed. Figure 1 represents proposed block diagram for automatic grinding machine

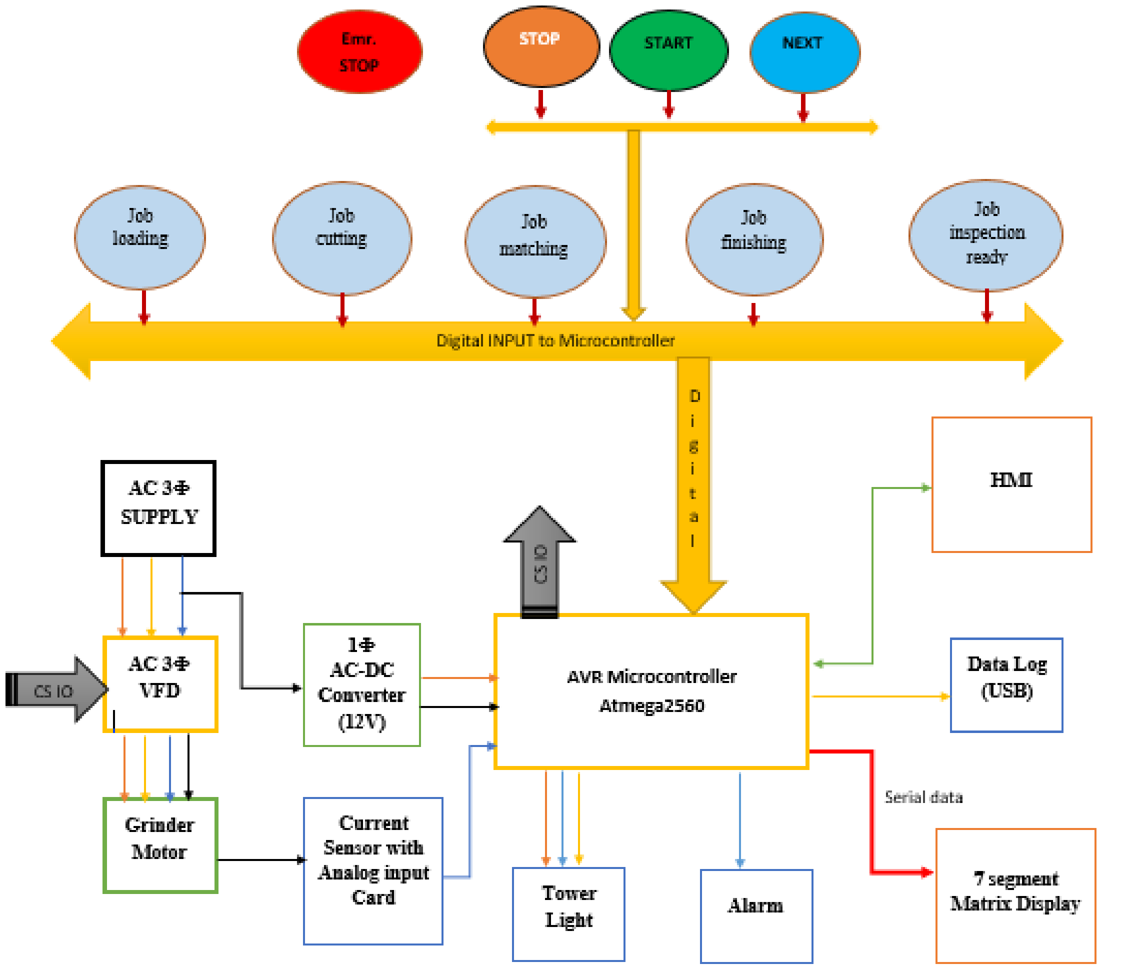


Fig. 1 Block diagram of proposed solution

## III. WORKING AND RESULTS

Start with figure 2 represent the flow diagram of automatic grinding machine. Flow diagram will help the operator to operate the machine as requirement.

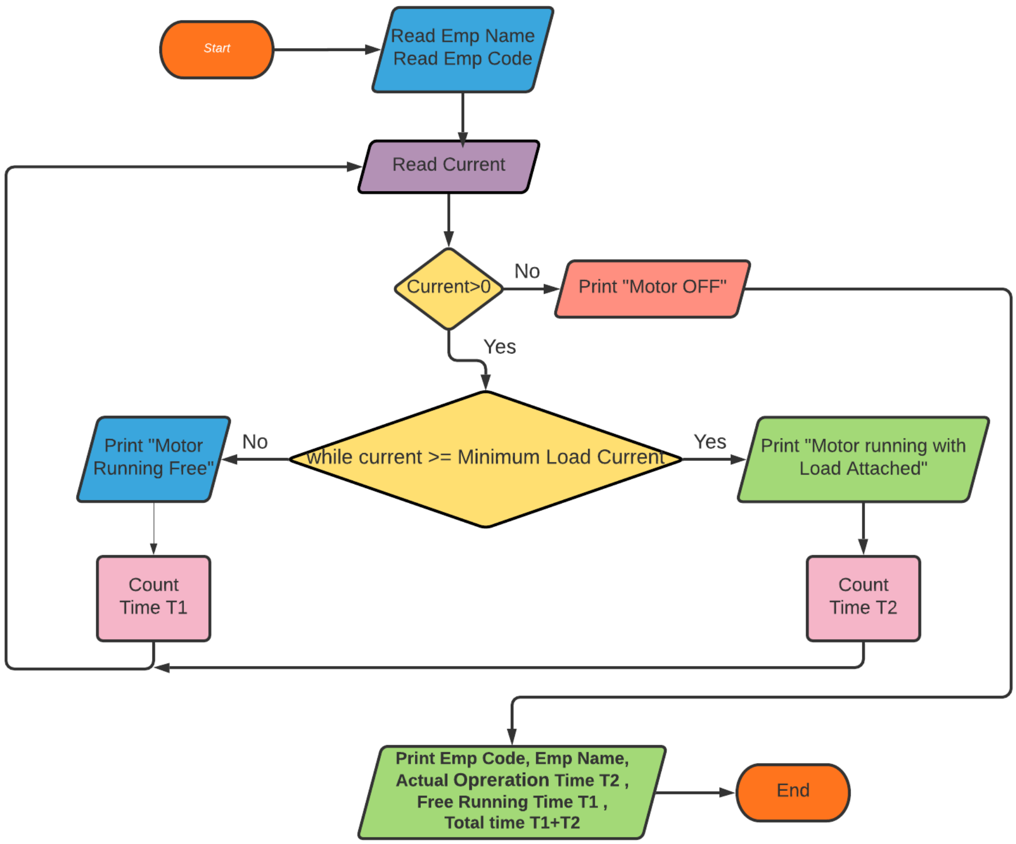


Fig. 2 Flow diagram of proposed solution

A). Current Sensor:

Current sensor is used to sense the current flow of motor. Current sensor work like as current transformer. Central to all of the AC power transducers is the measurement of current. This is accomplished using a current transformer (CT), a "donut" shaped device through which is threaded the wire whose current is to be measured. A current transformer is a type of "instrument transformer" that is designed to provide a current in its secondary which is accurately proportional to the current flowing in its primary.

B). Description of Electro-Mechanical Systems:

According to the projected grinding operation machine, the mechanical operations or jobs are divided into following parts.

1) Job Loading:

Job loading is the process of attaching the raw product of paper roller on the grinding machine. This operation is performed with the help of cranes and mechanical arms. It takes around 2 hours of time for the operators to fit or load the roller precisely on the machine.

2) Job Cutting:

In the job cutting process, the raw product i.e. unfinished rod is processed on the grinding machine. This functions helps remove the major irregularities of the surface. Additionally, this gets the rod diameter close to the required diameter.

3) Job Matching:

In the job matching process, the product operated upon with grinding machine is exposed to grinder 5um. Grinding operation matches the thickness (diameter) and finish of the roller. This process brings uniformity of thickness and finishing throughout the roller length.

4) Job Finishing:

In the job matching process, the product operated upon with grinding machine is exposed to grinder 0.2um. Grinding operation matches the thickness (diameter) and finish of the roller. This process brings uniformity of thickness and finishing throughout the roller length.

5) Job Inspection Ready:

Job Inspection ready is to check for deformities, scratches, cuts or cracks etc. in the finished product i.e. the rod. The purpose of this process is to check the product for one last time before the final inspection.

C). Description of Electronic/Embedded Systems:

At first the operator of the machine turns the power on and feeds details in the HMI (Human machine interface) including employee name, employee code, customer name and the job diameter. This information is displayed on the Led Matrix board which is placed on a visible height in the premises.

Now the operator selects JOB LOADING option and starts the loading operation. As soon as the option START is selected a counter is started. The COUNTER is attached to HMI through MICROCONTROLLER. On successful loading, the operator selects STOP option and the counter stops. If the counters runs for more than 2 hours, the ALARM is triggered.

After loading, operator selects JOB CUTTING on HMI and then selects START. This starts cutting operation on the LETH MACHINE according to required diameter. This starts the job grinding from one end to other end whenever the current goes upper or lower to set value Alarm is triggered if operator does not change the machine load with required value...

Operator selects the JOB MATCHING option on HMI and the selects START. This starts the grinder motor. An AC CURRENT SENSOR is attached with the grinder motor which reads its current parameter. Note that when load is attached, the current reading is higher as compared to when grinder motor is running while load is not attached. Hence, if current reading is lesser than expected, the alarm is triggered. When grinding is finished, STOP option is selected by the operator. Now the JOB UNLOADING option and then START is selected .This starts counter from zero with limit of 2 hours, exceeding to which the alarm is triggered. After the product is removed from the grinding machine safely, the STOP option is selected

Once the product is unloaded, JOB INSPECION READY option and the START is selected. This again starts the timer from zero with limit of 2 hours. During this time, the operator has to check for faults in the finished product before final inspection. And then select STOP option in the HMI for the last time.

## IV. CONCLUSION

The paper results demonstrate that the modernization of traditional control for the grinding machines can effectively handle by replacing the old components with new ones, made by (, microcontroller to maintaining the synchronization, speed with operator and machine. Electrical induction motor load interruption and torque limits. By replacing all the electrical command parts with the microcontroller and by fetching digital and analogue signal through microcontroller and VFD and displaying the important parameters on HMI which also shows the current state of the machine. This will help the industry to fetch the maintenance history, enter new parameters and diagnose the fault this will help for future planning of different values in an organized way because stored data can be viewed by teams of experts. As a result, paper web breakage could be minimized while empowering sufficient usage of the machine drive effectiveness.

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