



A New Era of Integration of PLC and Refurbishment in Automation Field

Deep.A.S¹, Rajkumar.P.Bainoor²

PG Student [Power Electronics], Dept. of EEE, PDA Engineering College, Kalaburagi, Karnataka, India¹

Assistant Professor, Dept. of ECE, PDA Engineering College, Kalaburagi, Karnataka, India²

ABSTRACT: This paper introduces the role of PLC, role of refurbishment and integration of both in automation sector with two case studies. Due to the growing technology our machines in the industrial sector can't compete with those technologies, so in a cost effective manner we can incorporate integration of PLC and refurbishment of existing machine to increase the productivity and accuracy with no maintenance.

KEYWORDS: Programmable Logic Controller (PLC), Human Machine Interface (HMI), Refurbishment and Automation.

I. INTRODUCTION

Controlling a system is very much essential in any undertaking project to reach our requirements. In the past humans played a major role in controlling the system. Later electrical control engineering was evolved to control the system more smartly using electro-mechanical relays. These relays replace the conventional switch to on and off the power. Using these relays only, they incorporated simple logical control decisions to automate their system. Over the years many machines are automated by incorporating mechanical gear system and electro-mechanical relays. In the recent years there is a demand for high quality, greater efficiency and accuracy in the industrial sector of all kinds. But now-a-days rapid growth in technology has come-up with different solutions such as PLC, SCADA, DCS and Microcontrollers, which will fulfill all the requirements of the industrial processes through automation[1].

Automation need not be high-end or too sophisticated but should be innovative in approach. It could be a phased approach or step-by-step approach to automate by understanding the needs thus employing control systems engineered to one's specific requirements that would achieve the most attractive results [2]. This paper will introduce the concepts of refurbishment and automation of machines and their advantages in section II and III respectively. The case study of refurbishment and automation of filament coiling machine with control methodology and hardware/software requirements are discussed in section IV. Performance Result and Conclusion are in section V and VI respectively.

II. REFURBISHMENT

Servicing and/or renovation of older or damaged equipment to bring it to workable or better looking condition is called refurbishment. Refurbished goods are of older model and usually in worse condition than reconditioned goods. Since customer today have access to world market due to globalization, liberalization, etc., they have open option to change more frequently their choice, as they have more variety of products with improved quality and lower price. Hence market life of product reduces such demands cannot be met by conventional ageing manufacturing machine tools because their limited capability, flexibility and become obsolete with time in countries with developing economics like India since capital constraints always prevail, up gradation of exiting machine tools through refurbishing & reconditioning is best possible answer to them. Refurbishing leads to cost effective modernization of existing industries [3].

The mechanical elements may still be in workable condition, however. And even if the machine's structure is worn, a new controller with closed-loop controls can often compensate for wear. A machine's age and the company's budget usually determine what to replace. Typically, the motion controller and/or Programmable Logic Controller (PLC) lie at the heart of a retrofit. Supporting the controls are transducers that track actuator position, pressure, force, valves that operate motion actuators, pumps and accumulators that ensure adequate flow capacity. Supplementing a new controller with a state-of-the-art Human-Machine-Interface (HMI) can reduce the time required to set up a machine when

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

production processes change. Using stored programs, complete motion sequences can be quickly downloaded to reconfigure operations [4].

III. AUTOMATION

PLC is need for Automation and Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. Automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience.

A. Automation Impacts

- It increases productivity and reduces cost.
- Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Performing tasks that are beyond human capabilities of size, weight, speed, endurance, etc.
- Automation is often applied primarily to increase quality in the manufacturing process.
- Automation reduces power consumption and reduces man power requirement.
- Automation improves production quality and quantity.
- Automation provides safer working conditions.

B. Programmable Logic Controller (PLC)

A programmable logic controller (PLC) is a solid-state device or digital computer used for automation of electromechanical process. It is an assembly of solid-state digital logic elements designed to perform logical decisions and provide outputs. Programmable logic controllers are used for the control and operation of manufacturing process equipment and machinery.

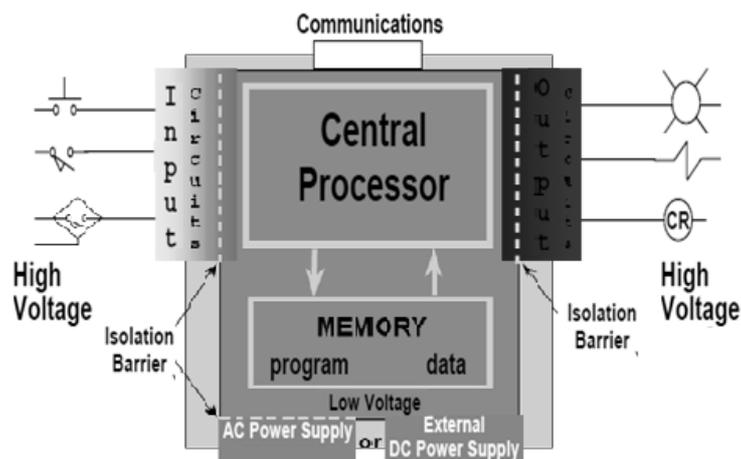


Fig. 1 Schematic of PLC & its Components

The PLC is basically a computer, designed to operate in industrial environment which uses a programmable memory for the internal storage of user-oriented instructions to implement specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital or analogue inputs and outputs, various types of machines or processes. Almost any production process can greatly enhanced using this type of control system [5].

Initially the PLC was used to replace relay logic, but it's ever increasing range of functions means that it is found in many and more complex applications. The structure of the PLC is based on the same principles as those employed in computer architecture.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

IV.CASE STUDY: FILAMENT COILING MACHINE

Filament Coiling Machine: The main aim of the project was refurbishment of one old machine using PLC. During inspection of the machine initially, the machine was found to be working partially and it is fully depending upon mechanical gear system and pneumatic cylinders. Now the whole operation including the operation of pneumatic cylinders is to control by the PLC panel. With these considerations, the main objective set for the project was to design, develop and implement automated controller for the machine in order to upgrade the technology. The major steps in achieving this objective are as follows.

- Disassembly and inspection of the machine to identify the faulty or defective parts.
- Assembly of the machine and check for its functionality along with replaced parts.
- Design the control circuit for automation of the machine as per the requirements.
- Build the control panel as per the designed control circuit by proper selection of equipment.
- Developing Automated control program using PLC software.
- Implement the control program developed and verify it for the desired automated control operation of the machine.

A. Control Methodology

The design stage on the project includes control design, hardware design, material selection and refurbishment of the machine. Although every step in the project was very important, the PLC based control development acts as heart of the project. This is illustrated in the block diagram shown in fig 2.

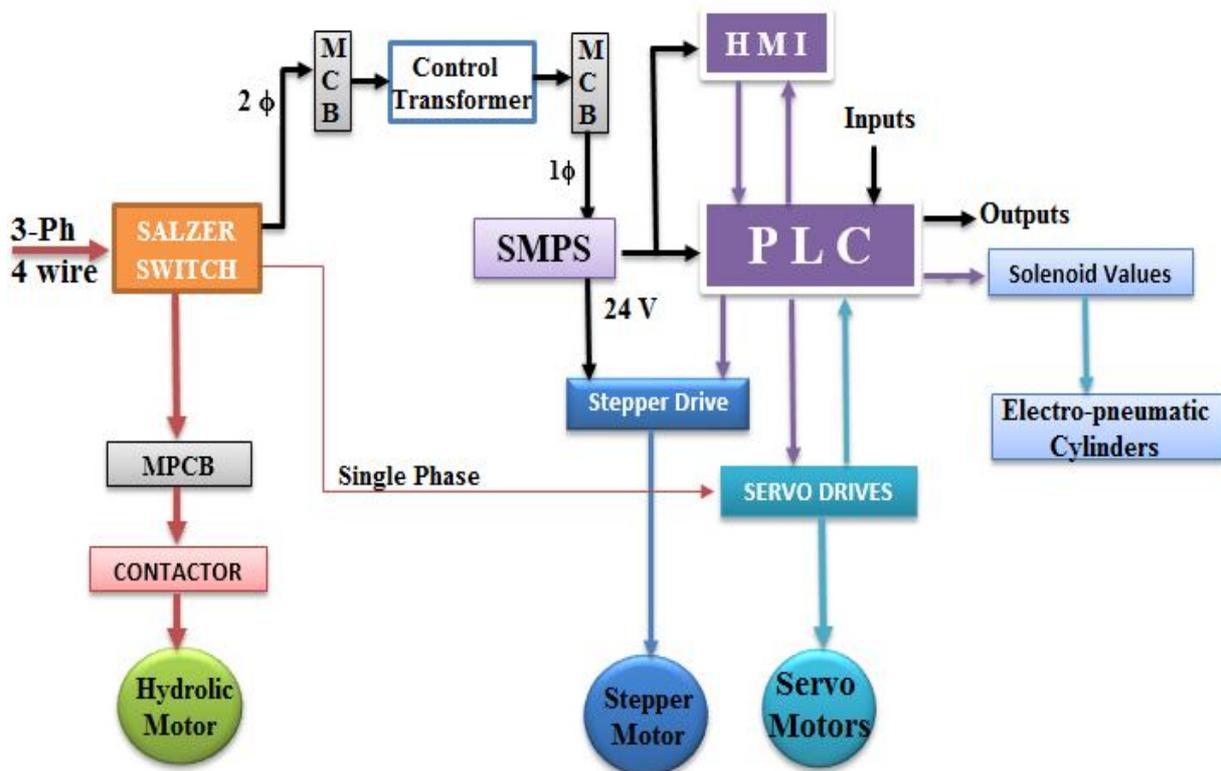


Fig. 2 BlockDiagram of the Filament Coiling Machine

A closed-loop control system for speed control is configured with speed feedback via inbuilt encoder (incremental rotary encoder) in the servo motors and the servo motors drives the load with variable speed using servo drives [6] by

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

this we can get accuracy in maintaining number of turns, pitch and leg length of the coil it is maintained by the stepper motor. The PLC monitors and controls all the inputs / outputs through HMI.

B. Hardware Requirements

The project incorporates various types of hardware related to switchgears, electro- pneumatics & automation. Thus the whole project hardware can be divided into two main categories, i.e.

- The PLC Control panel with accessories.
- The machine with solenoid valves and Electro-Pneumatic cylinders.

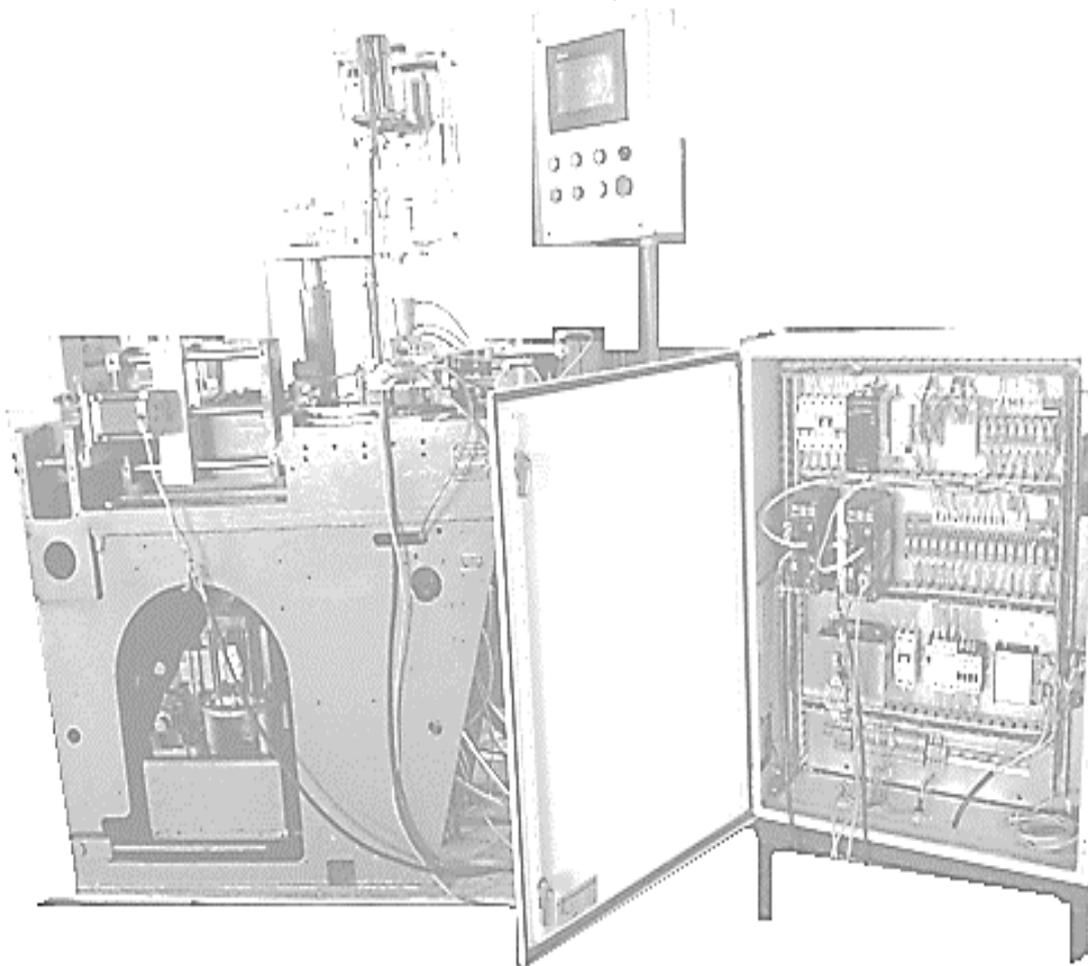


Fig. 3 Filament Coiling Machine with Control Panel & Accessories

The Machine and its Control Panel incorporating Switch Mode Power Supply (SMPS), Delta PLC (Programmable Logic Controller) and its Extension Modules, Relay Board, Servo Drives, Servo Motors, Stepper Drive, Stepper Motor, Control Transformer, Motor Protection Circuit Breaker (MPCB), Contactors, etc is shown in fig. 3 above.

C. Software Requirements

WPL Soft 2.41 - The main software required for Programming is *WPL Soft 2.41* - WPL Soft is a program editor of Delta DVP series PLC. There will be particular software for each brand of PLC, So for Delta PLC it is WPL soft and the Programming type is the Ladder Diagram Method. Ladder Diagram mainly consists of on and Off Logic, based on this logic only we write complete program. The Fig. 4 below shows the Screen shot of the WPL Soft 2.41.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

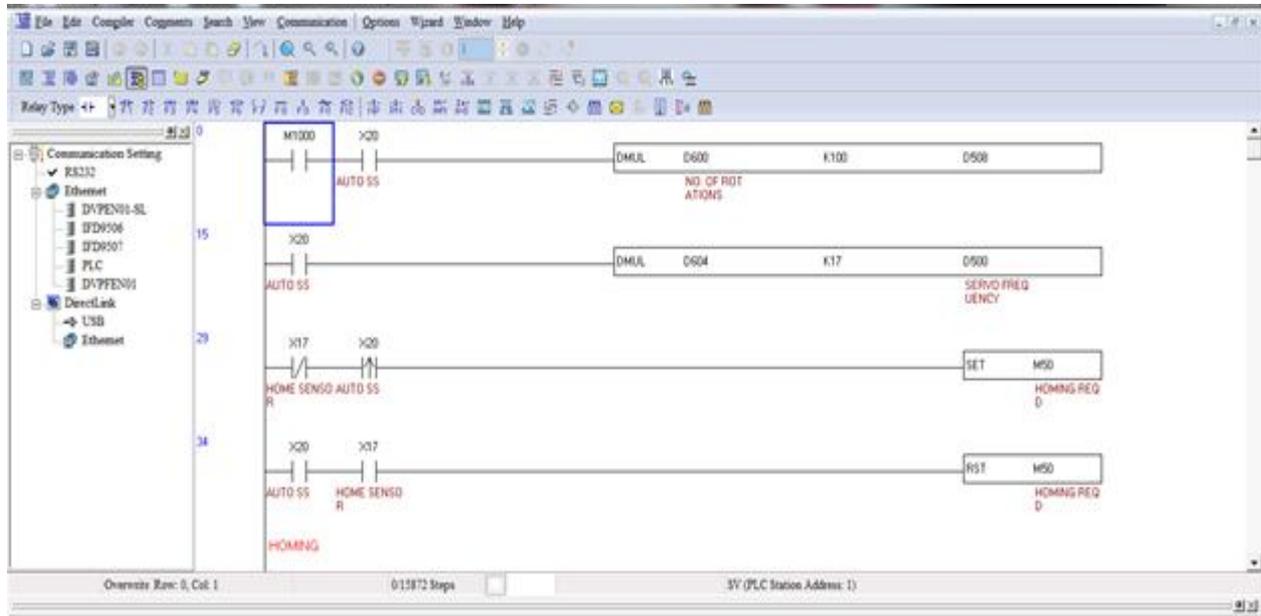


Fig. 4 Screen shot of the WPL Soft 2.41- PLC Software

DOP Soft 1.01.08 - It is the software required for controlling the operation through one display called Human Machine Interface (HMI). Here there is no need of writing program like in WPL soft. It is just like drawing sheet, we need to draw the I/O's according to our requirements like Push Buttons, Switches, Motors etc and we have link those buttons with suitable address to PLC program. The Fig. 5 below shows the Screen shot of the DOP Soft 1.01.08.

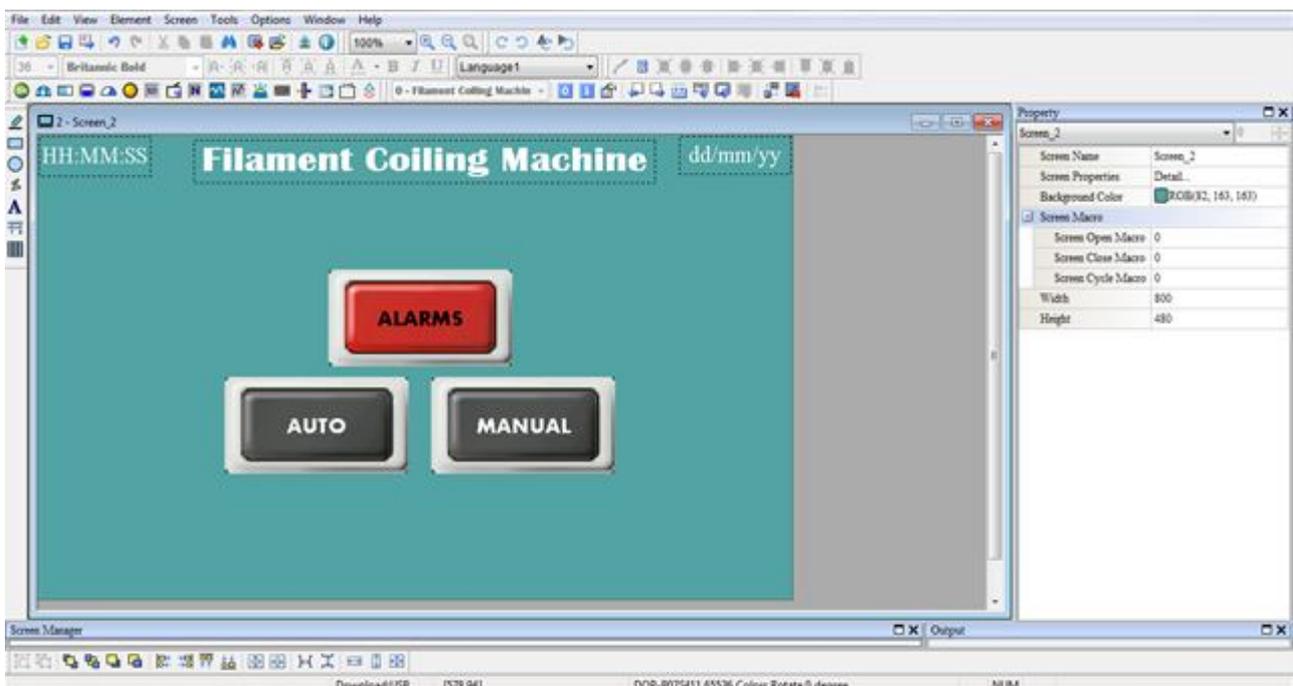


Fig. 5 Screen shot of the DOP Soft 1.01.08 – HMI Software

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

V. RESULTS AND DISCUSSION

Finally, the modern touch was given to the old machine by refurbishment and automation using PLC. The replacement of many previous functionalities like up and down movement of spindle depending on induction motor, wire feeding by a long pneumatic cylinder and so many gear systems to synchronize rotational and vertical movement with open loop system was modified to a closed loop system to get accuracy. The fig. 6 (a) General structure of filament coil and fig. 6(b) Actual filament coil obtained is as shown below. Coiling of tungsten filament wire from the machine has been met according to the company requirements like accuracy in number of turns, pitch, and leg length as shown in Table 1 below, thereby completed the project successfully.

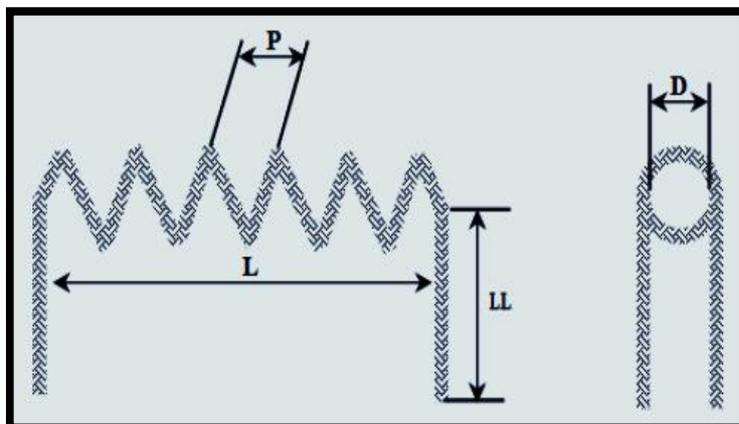


Fig. 6 (a) General structure of filament coil

Fig. 6(b) Actual filament coil obtained

Table 1 Dimension Details of the actual filament coil

Description	Filamentcoil
NumbersofturnsintheCoil (T)	16turns
Fulllengthofthecoil(L)	40mm
Leglengthofthecoil(LL)	40mm
InnerDiameterofthecoil(D)	8mm
Pitchofthecoil(P)	2mm

VI. CONCLUSION

The growth in various technologies has led the old machines worth less. Instead of treating it as scrap we can refurbish it using functioning components as much as possible and replacing other requirements by new technologies, so that we can obtain the refurbished old machine and automated to gain accuracy, increased productivity as equivalent to that of a new machine.

ACKNOWLEDGEMENT

I would like to express my gratitude to Laxmi Control System, Mysore, for providing me an opportunity to Carry-out the Project work. We are extremely grateful to our coordinator Dr.M.S.Aspalli, for his constant encouragement, support and extending all necessary facilities to take up this endeavor. I would like to express my gratitude to my honorable guide & co-author Asst. Prof. Rajkumar P Bainoor for his guidance and support throughout my work. He has been a constant source of inspiration to me.



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

REFERENCES

- [1] P. Gendarz and W. Janik, JAMME, “Refurbishing technologies of hydraulic actuators applied in mining industry”, Journal of Achievements in Materials and Manufacturing Engineering of Achievements in Materials and Manufacturing Engineering, Volume 4 Issues 1-2, July-August 2010.
- [2] Abhi Chaudhary, Tasmeem Ahmad Khan, Amit Raj Varshney, IJSET, “Value Addition to Senescent Machine Tools through Retrofitting”, International Journal of Scientific Engineering and Technology, ISSN : 2277-1581, Volume No.2, Issue No.7, pp : 642-646 1 July 2013.
- [3] P Kurnakaran and S Meyyappan, a cover story on “Rejuvenating machine tools”. Industry watch, Modern Machine Tools, April 2005.
- [4] Pampashree, and Dr. Md. Fakhruddin Ansari, ISSN, “Design and Implementation of SCADA Based Induction Motor Control” , Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol.4, Issue 3 (Version.5), March 2014, pp.05-18.
- [5] Bharath, SiddharamPatil, R M Lathe. ISSN “Shaper Automation Using Electro-Pneumatic Devices and Plcs”, International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, Volume 8, Issue 2 (August 2013), PP. 49-56.
- [6] Maria G. Ioannides, Senior Member, IEEE, “Design and Implementation of PLC-Based Monitoring control System for Induction Motor”, IEEE transaction on energy conversion, vol.19, no.3, 2004.

BIOGRAPHY



Mr. Deep.A.S received his BE degree in Electrical and Electronics Engg. from NIEIT, Mysore and currently pursuing M.Tech in Power electronics branch, Electrical and Electronics Engg., Dept. PDA College of Engineering, Kalaburagi, Karnataka, India. His current research interests include Industrial Automation and Renewable sources of Energy.



Mr. Rajkumar. P. Bainoor is Assistant Professor in the Dept. of E & CE, P D A College of Engineering, Gulbarga, Karnataka, India. He obtained his B.E in Electronics and Communication Engineering from Gulbarga University, Gulbarga in the year 2001, and M.Tech degree in Power Electronics from VTU Belgaum in the year 2007. He has published 4 papers in International Conferences and journals. His areas of interest include Power Electronics, PLC, Image Processing, Computer Networks, and communication System.