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Velcro Cutting Machine using PLC Programming with Stepper Motor and Encoder

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Abstract

Reducing the human efforts while manufacturing the product is an important factor which is considered in industry. Designing the system with very less or without any human participation is the main focus of manufacturing industries. At the same time focus is on increasing productivity and reduce the processing time. Proposed a system is 'Velcro Cutting Machine with Stepper motor and encoder using PLC programming is an automated system which will help the industries to achieve above objectives. PLC is a main controller which will accept the input and take control action on the stepper motor. The cutter is attached to a stepper motor. The actions of the cutter are controlled by the stepper motor rotations. An HMI will be used by user to provide inputs. This is how this Velcro cutting machine will help in reducing human efforts and increasing productivity.

Keywords--- *Velcro cutting machine, Stepper motor, PLC, HMI.*

I. INTRODUCTION

Proposed system is 'Velcro cutting machine with stepper motor and encoder using PLC programming is an automated system. The major goals and objectives ofour project is to reduce human efforts, designing the system with very less or withoutany human participation. At the same time focus is on increasing productivity and reduce the processing time.The main part of this project is Programmable Logic Controller. We are controlling theoperation of Velcro cutting machine using a Programmable Logic Controller. Any activity that needs high consistency control and ease ofprogramming and process fault diagnosis uses a PLC.They havebeen mostly adopted as high-reliability automation controllers suitable for harshenvironments. A PLCs output resultsmust be produced in response to input conditions in a limited time, else unexpectedoperation will result.In this project, the interface of the press and the PLC is on the basis of a sensory system.The switches are used to operate the state of the machine (ON/OFF). Using steppermotor we control the rotation of the roller. Encoder is used to give pulse per revolution.Heater is used to heat the cutter of the machine to cut Velcro piece properly.Temperature sensor is senses the temperature of the heater and gives feedback to thePLC. All this components are controlled by PLC. The PLC programming can be donein traditional ladder diagrams, PLC ladder diagrams and using flow chart algorithms.We have used PLC ladder diagram method for programming in this project.

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II. LITERATURE SURVEY

[1] Bhagyesh A. Vaidya, Swapnil V. Sawant, Pramod R. Shirke "Review on design and development of PLC operated cutting machine". GRD Journals-Global research and Development Journal for Engineering, January 2018, ISSN: 2455-5703.This paper reviews PLC application in industry of cutting machines. Also gives information regarding PLC properties and cutting hardware. The conclusion obtained from this paper isthe overall Material cost is reduced significantly. Development time for manufacturing is reduced.

[2] RushikeshGadale, SanchitTayade, S .V Kulakarni. "PLC based automatic cutting machine". International journal of engineering and technical research, March 2015, ISSN: 2321-0869. This paper helpsto understand the application and importance of involvement of automation in conventional cutting machine in manufacturing. Also For cutting machine based on PLC has got faster execution time and is more efficient. The system presented in paper is more flexible.

[3] ShashiSahu, Satya Kumar, Behra, Amar Kumar Dey "Review of automated profile cutting machine using PLC". International journal of digital application and contemporary research, May 2015, ISSN: 2319-4863. This paper presents how to work on profile cutting machine by using PLC techniques. This paper tells the importance of automation in Industry. The techniques used in paper is mainly used for industrial applications. Also it concludes that using PLC machine is made more reliable and efficient.

[4] Dr Rahul Pawar, Dr N. R. Bhasme "Application of PLC's for Automation of Processes in Industry." International journal of engineering research and applications, June 2016, ISSN: 2248-9622. This paper Reviews PLC application in automation industry. This paper also gives information about how PLC is better than other controllers. Also gives information regarding industrial automation system. The use of PLC in automation system increases reliability and flexibility. At the same time it reduces the cost.

[5] J Bathelt, A. Jonsson, C Bacs "Conceptual Design Approach for Mechatronics Systems Controlled by Programmable Logic Controller (PLC)." International conference on engineering design, August 2003. This paper gives information regarding SFC programming of PLC. Use PLC makes system more simple and Flexible

[6] Gavali Amit Bhimrao, PatilMahadev S. "PLC based Industrial Automation System." International conference on Recent Trends in Engineering and Management Science, April 2014, ISBN: 978-3-642-24819-9. This system gives information regarding Software of PLC. Also shows PLC based control Panel for automated system. Troubleshooting aids makes the PLC programming much more easy. PLC based systems are simple and more flexible. This paper compares automation using old technologies like relay contactor logics and concludes that it PLC is more simple and flexible controller for automation.

[7] SmitaKumari and SeemaKumari "Traffic Control System Using PLC." International Journal of Engineering Science and Computing, April 2017. This paper tells us about Ladder Diagram

Programming of PLC. In previous paper we have learnt about SCF programming of PLC. After studying this paper we can conclude that Ladder Diagram Programming method is simple programming method for PLC. Also they have used NC and NO switches in there system.

[8] PrepalliRamanamma. "Implementation of Vending Machine Using Programmable Logic Controller." International Journal for Research in Applied Science and Engineering Technology, June 2018, ISSN: 2321-9653. This paper gives information regarding Sequential Function chart for PLC. Also they have discussed about Unemployment issue due to Automation. This paper concludes that the future scope of PLC is very vast in industry of automation due to its flexibility and automation. Also the have concluded that automated system have an issue of adopting to various new scenarios.

[9] MV Vagh, Vaishalighghadaml, SampadaMapari "Automatic Object Printing Machine using PLC" International Journal of Advance Research in Electronics and Telecommunication Engineering, May 2017, ISSN: 2278-909X. This paper reviews how traditional system are getting replaced by automated systems. PLC based systems reduces the maintenance cost. Also it increases Accuracy. But in this case it resulted in large circuit. They have also used conveyor belt and proximity sensor for ease in operation.

[10] MenakaKural and H. Prasanna Kumar"Auotomated Washing Machine Using PLC. "International Journal of Software and Hardware research in Engineering, September 2018, ISSN-2347-4890. This paper proposes information regarding automation of daily home needs. They have implemented basic PLC functioning like timing, sequencing and relaying. Also gives information regarding ladder Diagram Logic. The System is Cost efficient and human efforts are reduced.

III. PLC

PLCs were invented by Dick Morley in 1964. Since then PLC is rising in theindustrial and manufacturing sectors. There is a huge range of PLC functions like timing, counting, calculating, comparing and processing of various analog signals.The main advantage of PLC against hard-wired control system is that you can go backand change a PLC after you've programmed it, at little cost. In a hard-wired controlsystem, you're essentially needs to change the wiring of the system for any change in control functions(which is moreexpensive and takes longer). Let's look at an example to better understand thisadvantage.Imagine you have a light connected to a switch. In general, the light operates under two conditions – ON and OFF. Now you are given a task that when you turn ON the switch,the light should glow only after 30 seconds. With this hard-wired setup – we're stuck.The only way to achieve this is to completely rewire our circuit to add a timing relay.That's a lot of hassle for a minor change.Programmable Logic Controllers constantly monitors the input values from variousinput sensing devices (e.g. accelerometer, weight scale, hardwired signals, etc.) andcreates respective output depending on the nature of production and industry. Ablock diagram of PLC consists of five parts namely:

- Rack or chassis
- Power Supply Module
- Central Processing Unit (CPU)
- Input & Output Module
- Communication Interface Module

IV. METHODOLOGY

With further coming technologies and availability of motion control of electric drives,the application of Programmable Logic Controllers with power electronics in electricalmachines has been introduced in the

development of automation systems. The use of PLCin the process of automation increases reliability, flexibility and reduction in cost of production.Use of PLC connected with power converters, personal computers and other electricequipment makes industrial electric drive systems more accurate and efficient. PLCs havebeen gaining popularity on the factory floor and will probably remain important in comingyears. Most of this is because of the advantages they offer, like

• Cost effective for controlling complex systems.
• Flexible and they can be reapplied to control other systems quickly and easily.
• Computational abilities allow more sophisticated control.
• Trouble shooting makes programming easier.

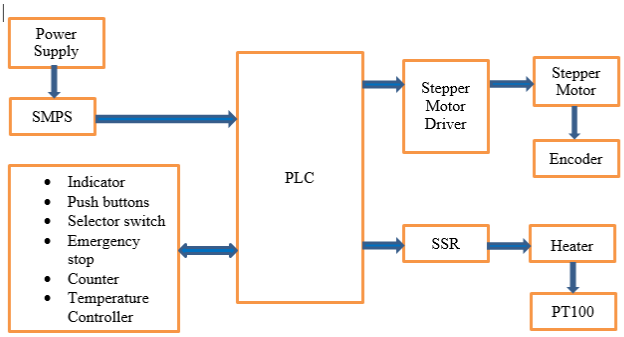

Fig. 1Block diagram of system

The various examples of PLC based Machine are:
1. PLC based automatic Washing Machine.
2. PLC based Automated Printing Machine
3. PLC based Automated Vending Machine
4. PLC based Automated Drilling Machine

Fig. 2HardwareSystem

V.DESIGN CALCULATIONS

Circumference of circle =2*pi*R
Shaft of Motor = Pi*D

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So, Pi*D = 3.14 *32mm= 100
So in one revolution 100mm of material is passed & we have 1000 Pulse per revolution (PPR) Encoder.
So for one revolution = 1000ppr
100mm=100ppr
So we need 50mm& 120mm Velcro cutting
So for 50mm= 500PPR encoder

VI. RESULT

Fig. 3Velcro cutting machine

Above figure shows the final proposed system of velcro cutting machine. In this system PLC programming is used. As PLC is used to control the system, the control functions can be changed simply by changing the program. But if we used Hardwired control systems then it is not possible to change control functions by changing the program. It requires to change the wiring of system.

Fig. 4 User Interface

Fig.5Control Panel

Above two figures shows the user interface and control panel of the system which consists counter, temperature controller, indicator, push buttons, selector switches, emergency stop, PLC, stepper motor and driver etc. This velcro cutting machine helps to improve the quantity and quality of velcro pieces as

compared to human efforts. It cuts 5000-6000 pieces per day with dimensions such as 50x50mm and 50x120mm.

Fig. 6Velcro piece

VII. CONCLUSION

A PLC for velcro cutting machine is programmed in order to obtain the velcro pieces of the desired dimension. Velcro pieces of desired dimension can be cut from velcro tape using velcrocutting machine using PLC.Programming of PLC is done in order for the further operations of the machine.

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