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INTELLIGENT PLC SYSTEM TO CONTROL WIRE CUTTING MACHINE

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Abstract— today, the concept of retrofitting is a common principle in the pursuit of renewing outdated machine tools. The involvement of automation in conventional cutting machine becomes a must. It will improve mean-time between failures, mean-time to repair and will save energy as well. The wire cutting and straightening machine is selected to be retrofitted, because the machine is mechanically good. . And the retrofitting is based on a PLC control scheme. The machine used has specified length to suit the required length for the shelves and basket used in air cooler refrigerators plant, so it is a very important machine in the company production line, any failure in any part will cause a considerable delay in the final production line. PLC is a suitable the manufacturing environment [1]. This paper an attempt is made to replace the conventional control system with a PLC system in old machine. The result shows a good improvement in down time. There drop in down time percent from 86% and 23% in years 2014 and 2015 respectively to .0.08% in year 2018 after implementation of PLC.

Keywords— retrofitting, downtime, wire cutting machine, Micro win /SP3, S7-200 PLC

I. INTRODUCTION

Today, the concept of retrofitting is a common principle in the pursuit of renewing outdated machine tools. Retrofitting is defined as steady modification of an existing machine tool and comprises activities such as turning-off or replacing components of machine tools such as electrical components and control system to save energy, and minimize downtime [2, 8]. Additionally, these cost-effective solutions of automation are equally beneficial to small, medium and large industries. Industrial automation is largely based on PLC-based control systems [2]. Researchers studied this concept revealed that Retrofitting is typically an optimum alternative to purchasing new costly machine tool. It will improve mean-time between failures and mean-time to repair. Additional benefits can be realized in energy savings, performance improvement and improve access to manufacturing data [1, 2, 6, 8, 9].

Implementation of quick and efficient industrial processes is the main objective for any manufacturing company. This eliminates the needs for off-line quality control and part inspection. Automation leads to high performance machining and labor savings. Having an intelligent and real-time quality control for the products. The wire cutting machine is one of the oldest machines working in the production line, it is controlled classically by electromagnetic relays due to this many problem arise and the machine production stopped continuously and becomes noisy. Actually this machine is one of the important machines in the cold-air production line. The machine has specified length to suit the required length for the shelves and basket used in air cooler and refrigerators. Considerable savings of both time and labor during the inspection process can be achieved in the wire cutting machine of discrete components through gains in automation and high-performance machining. The major goals and objectives of this project is to investigate retrofitting a control system able to reduce stoppage times due to faults caused by electromagnetic relays, improve product quality, reduce the total cost by reducing labors and time and unnecessary manual quality inspections. Other benefits can be sought include waste reduction, and improve safety by reducing injury accident due to entering the working zone of cutting and feeding.

II. PROGRAMMING SOFTWARE

B. STEP7-Micro/WIN32 provides a user-friendly environment to develop, edit, and monitor the logic needed to control your application. At the top is a quick access toolbar for frequent tasks, followed by menus for all common functions. At the left is the project tree and navigation bar for easy access to components and instructions. The program editor and other components open occupy the remainder of the user interface. STEP7-Micro/WIN SMART provides three program editors (LAD, FBD, and STL) for convenience and efficiency in developing the control program for a certain application. To help finding the information needed, STEP7-Micro/WIN32 provides an extensive online help system.[5]

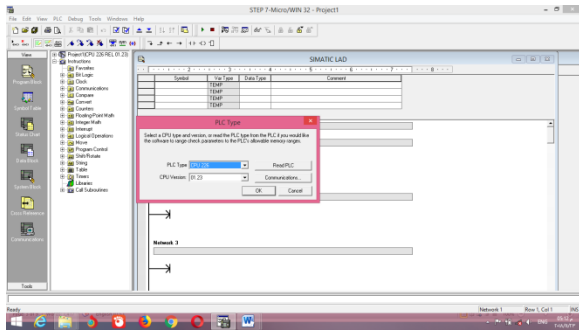


Figure 1 STEP7-Micro/WIN 32

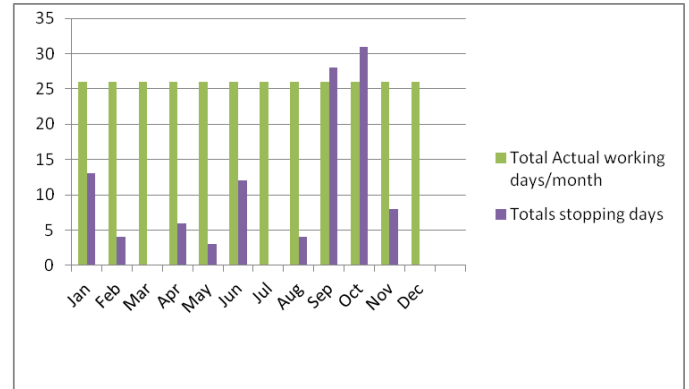


Figure 3 Wire Cutting Machine Stopping Days During the year 2015

A. The Problem: –

As the time pass machine tools generally deteriorate and the performance, as result, deteriorate. Consequently many problems arise, such as delays, poor quality, and poor employee morale. In Cold-air plant the wire machine encountered similar problems such as accuracy of cutting length, production delays, high waste rates and poor quality. This leads to a very expensive operating cost. Safety issues reflected in high operator’s injury is noted. Figure 2 and 3 shows the periods in which the machine stopped working during 2014 and 2015 detailed by months and completely stopping in 2016 and 2017, which is a summary of Tables extracted from the Cold-air system. During July 2014, September and October 2015 down time is much greater than the working time. Generally down time during 2014, 2015 is about xx%. This prompted the researchers to think and make some modifications in the operating system of the machine to improve performance, increase efficiency and improve the protection methods for the employees and the machine.

C. Developing the Machine System

STEP 7-Micro/WIN32 is the program software used with the S7-200 PLC to create the PLC operating program. STEP 7 consists of several instructions that must be arranged in a logical order to obtain the desired PLC operation [5]. The flow chart shows in figure 4 the sequence of operations of the new developed system.

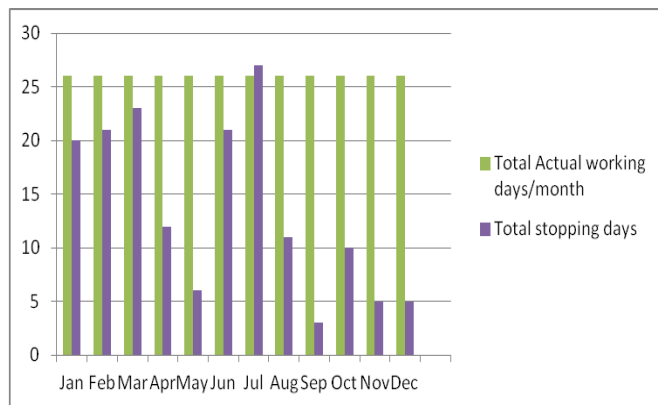
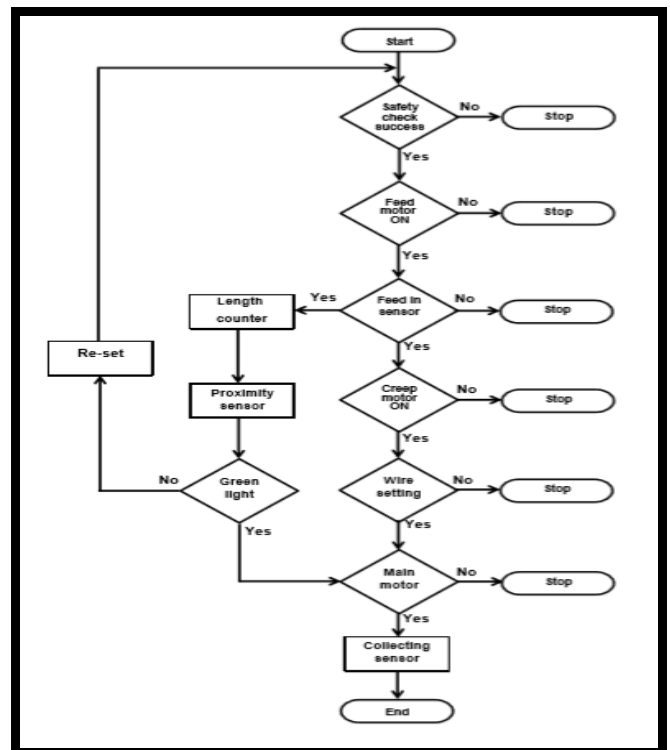


Figure 2 Wire Cutting Machine Stopping Days During the year 2014





III. RESULTS AND RESULTS

Stopping due to electrical faults, was the main reason for the modification of the method of controlling the machine electrically and to show the effectiveness of the new control system we can compare the performance of the machine electrically before and after the adjustment Tables (1,2 and 3) indicate the stop hours for 2014-2015 and 2018 and Figure (5) Stop graphically,

Stopping Days				
Month	From	To	Total Actual working days/month	Total stopping days 2014
Sep-14	01/09/2014	04/09/2014	26	3
Oct-14	01/10/2014	10/10/2014	26	10
Nov-14	25/11/2014	30/11/2014	26	5
Total of Total			78	18

Table 1

Stopping Days				
Month	From	To	Total Actual working days/month	Totals stopping days 2015
Sep-15	02/09/2015	30/09/2015	26	28
Oct-15	01/10/2015	31/10/2015	26	31
Nov-15	12/11/2015	16/11/2015	26	8
Total of Total			78	67

Table 2

Stopping Days				
Sep	From	To	Total Actual working days/month	Totals stopping days 2018
Oct-18	01/08/2018	30/08/2018	26	4
Nov-18	01/09/2018	30/09/2018	26	0
Sep-18	01/10/2018	31/10/2018	26	2
Total of Total			78	6

Table 3

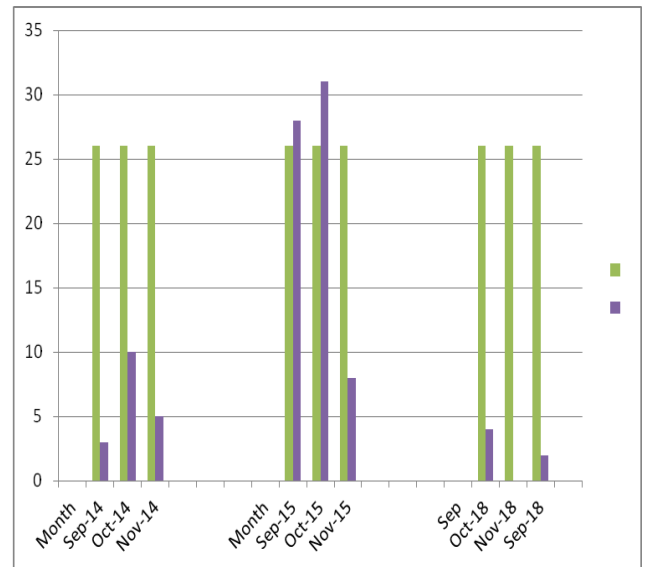


Figure 5 Wire Cutting Machine Stopping Days during the year 2014 -2015 and 2018

From the above data it could be clearly noted:

- 1- Stopping hour's percentage during the last three month in 2014 is $\left(\frac{18}{78}\right) \times 100 = 23\%$
- 2- Stopping hour's percentage during the last three month in 2015 is $\left(\frac{67}{78}\right) \times 100 = 85.9\%$
- 3- Stopping hour's percentage during the last three month in 2018 is $\left(\frac{6}{78}\right) \times 100 = 0.077\%$

The above simple comparison indicate the great improvement in the machine performance and thus the overall efficiency of the machine

IV. CONCLUSION

The machine electrical control system modification has been accomplished by creating a new circuit for controlling and operating and safely, this gave many economical and technical benefits such as it respond quickly to changing market conditions in a way that creates a sustainable competitive advantage also minimize total cost and create a system which is easily maintainable/ upgradeable for the long-term finally achieve its future goals and vision of company.

One of the most important features of PLCs. Soft wiring makes changes in the control system easy and cheap. If it want a device in a PLC system to behave differently or to control a different process element, all have to do is change the control Program. In a traditional system, making this type of change would involve physically changing the wiring between the devices, a costly and time-consuming endeavor. [7]



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