

Development of PLC and SCADA based Central Alarm System for Glass Bottle Manufacturing Industry

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Abstract

Alarms are one of the most important aspects of a glass bottle manufacturing industry. Whenever there is a fault in any equipment of industries, the alarm will be active. The operators are taking responsibility to mitigate the fault after watching the alarm. However, the position of alarm is a very crucial factor. Normally, every alarm is located with the equipment. This can be a problem when no one notices the alarm for a long time, which causes a huge production loss. This paper introduces a PLC and SCADA based central alarm system, where the alarm can be located in the middle of the Hot End and Cold End section, where every people can acknowledge the alarm. Moreover, a buzzer can be introduced. The exact location of the fault is seen by SCADA. By the use of VNC software, Hot End and Cold End sections can view the SCADA window and take necessary actions, whenever the fault occurs. Moreover, a fault control system is being introduced, where bottles are falling down after one bottle will getting stuck and no one acknowledges the problem, which causes a huge loss. In our system, we present a system, where conveyor stops and the alarm will glow after the problem occurred, which connects with central alarm. This improves the production rate.

Keywords

PLC, SCADA, Central Alarm, VNC Server, VNC Viewer.

1. Introduction

For the glass bottle manufacturing industry, alarms from machines are very crucial, which is introduced by ZongXuejun et al. Most of the time, workers don't acknowledge the alarms in time and it causes a huge production loss. In this paper, we introduce a system, where central alarm will work when any of the alarm will work. Moreover, Huang Qian et al. and Emil ZaeV et al. developed SCADA system for monitor the alarms every time.

For an instance, Glass bottle manufacturing industry 'X' introduces a lot of alarm systems and each alarm is responsible for different types of difficulties. Hot End (HE) alarms are Annealing Lehr fault, hot end coating alarm, IS cooling fan alarm (High and low), cooling conveyor alarm, RO system failure or shear spray alarm, RO pump failure alarm, oil lubrication low alarm, feeder combustion air fan failure alarm, low air pressure alarm, tube rotation alarm, stacker alarm and plunger feeder alarm, while Cold End (CE) alarms are infeed stopper of Evolution 12 and 5 alarms, ISM infeed alarm and CE coating alarm. As an example, annealing lehr fault stops the belt drive. So no bottles can pass and it can make a huge jam of bottles, if it's not acknowledge in short time. Because bottles are passing from Hot End (HE) side at that moment. If the alarm works in cooling conveyor, then it stops the conveyor due to heating. These problems need to be resolved as early as possible. Otherwise, there will be a significant amount of production loss.

Glass bottle industry 'X' introduces Hot End (HE) and Cold End (CE) sides, which is shown in Figure 1. HE section includes mould design (JanezKopac et al.) and mixing. After Hot End side, annealing lehr to counter is the Cold End (CE) side. Annealing lehr helps the glass bottle from breakdown by reducing the temperature gradually. Then Evolution 12 machine is responsible for detect the sidewall inspection, whereas Evolution 5 machine base and finish inspection and reject the defect bottles. OLT AGR helps to detect the problem with glass thickness, which is presented by Yang Ni et al. MettlerToredo machine detects metal in glass bottle. ISM Ranger machine spots the

problems with crack in bottles, which is presented by Scott McCann et al. At last, some workers check the bottles visually and then, counter counts the bottle numbers.

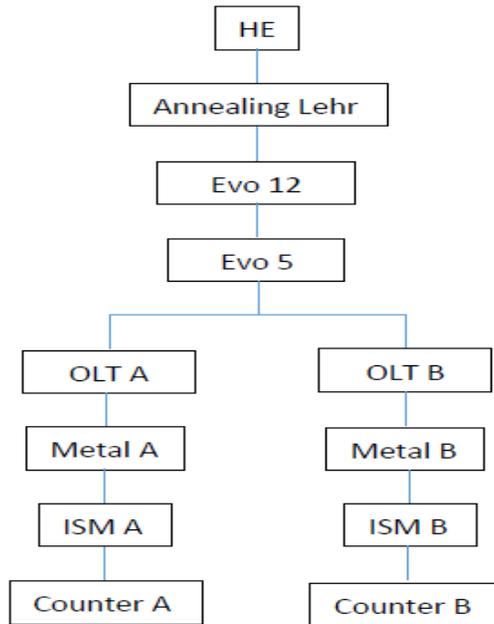


Figure 1: Total Process of Glass Bottle Manufacturing Industry

In industry 'X', from OLT to Metal, some bottle is falling down whenever one bottle stop before the chute of OLT reject. The chute is shown in figure 2. However, we solve this problem with the help of 2 sensors which is located before OLT and Metal machine. For that, it uses 1 PLC with input and output module. At input module, it connects the sensor, whereas at output module connects the conveyor stop and alarm with the help of relay. This system is connected in one line, where 2 positions (A & B) are located, which is shown in figure 1. So, we connect 2 sensors for 1 position, which means, we use total 4 sensors for this work. All sensors are shown in Figures 3-6.

When the bottle is going through OLT sensor but it's not passing before Metal sensor, then after a while, the conveyor will stop automatically in that position and alarm and central alarm will glow at the same time, which indicates, the conveyor stops already. After acknowledging the problem, checker can check and conveyor will start after fault removal. The alarm is shown in Figure 7.



Figure 2: OLT reject chute



Figure 3: OLT A sensor



Figure 4: OLT B sensor



Figure 5: Metal A sensor



Figure 6: Metal B sensor



Figure 7: Alarm used for both positions (A & B)

2. Methodology

The block diagram of central alarm system is shown in figure 8. Here, infeed stopper of Evolution 12 and Evolution 5 machine, Cold End (CE) coating alarm, and Hot End (HE) alarm is connected with PLC input via relay. Infeed stopper works when alarm works at Evolution 12 and Evolution 5 machine. All alarms are connected with central alarm and central alarm connects with PLC output via relay. All PLC inputs and PLC outputs are connected with PC.

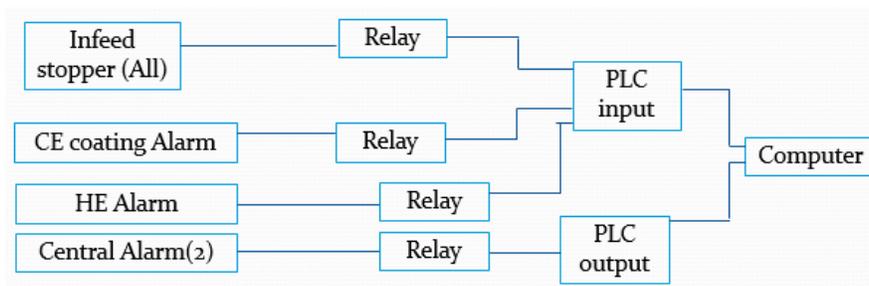


Figure 8: Block Diagram of Central Alarm System

A problem occurs in OLT reject chute, where bottles fall down when one bottle stuck before OLT reject chute. This makes a huge loss in production. Around 200-300 bottles fall down before someone being acknowledged this problem. Figure 9 introduces the block diagram of bottle falling protection system. Chute is located in the middle of OLT sensor and metal sensor. If OLT sensor senses 25 bottles (Changeable) and Metal sensor doesn't sense any bottles, then conveyor belt stops automatically and alarm will glow. These alarm is located near counter, where

checker checks the bottle visually. So, he/she easily recognize the alarm when it will glow and take necessary actions. This alarm is also connected with central alarm system.

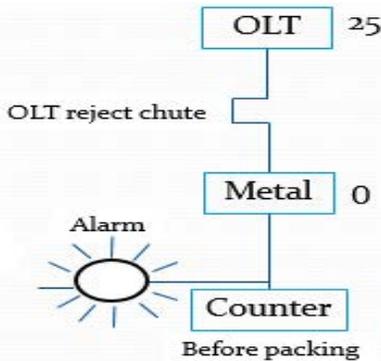


Figure 9: Block Diagram of bottle falling protection system

Figure 10 represents the control diagram of conveyor stop. Conveyor stops and alarm for bottle falling with the help of input module of PLC, whereas output module of PLC will be responsible for central alarm in SCADA window.

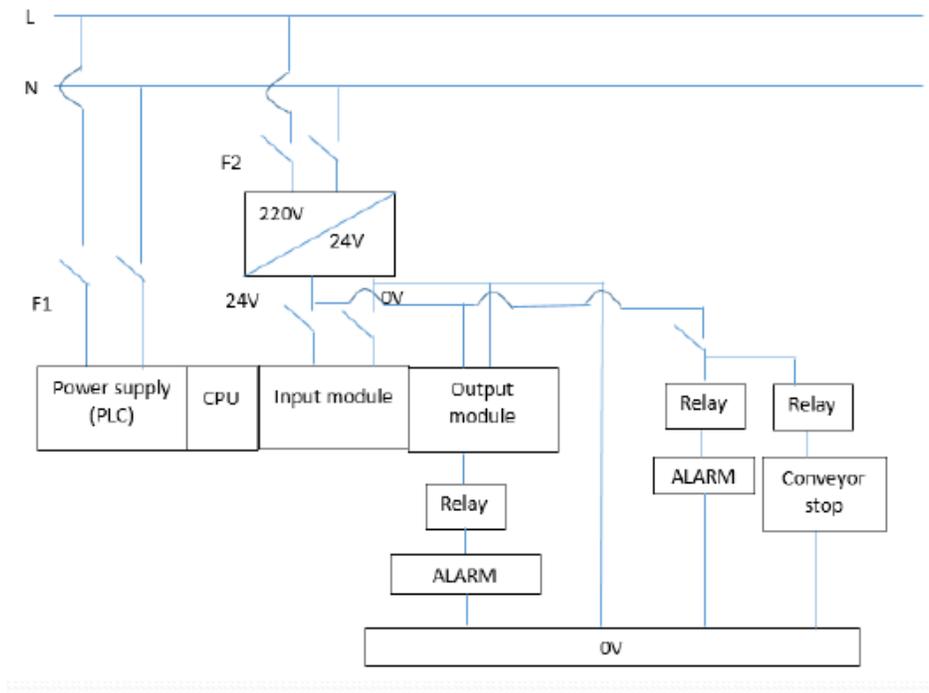


Figure 10: Control Diagram of Central Alarm system

Electrical design of conveyor stop system is shown in Figure 11. Output of plc connects with conveyor via relay. Figure 12 introduces the flow chart of central alarm system. Firstly, OLT A, OLT B, Metal A and Metal B sensors are located. Then all sensors, alarms, conveyor belt stop and infeed stoppers are connected with PLC. If the alarms of Hot End (HE) and Cold End (CE) is worked, then central alarm will glow. Moreover, if OLT sensor senses 25 but metal senses 0, then conveyor stops and alarm of chute glows, which will activate the central alarm. After the checker will check and remove the problem, the alarm will inactive and conveyor runs normally.

3. Results and Discussion

Figure 13 shows the SCADA window, where anyone can change the number of bottle difference between OLT and Metal sensor.

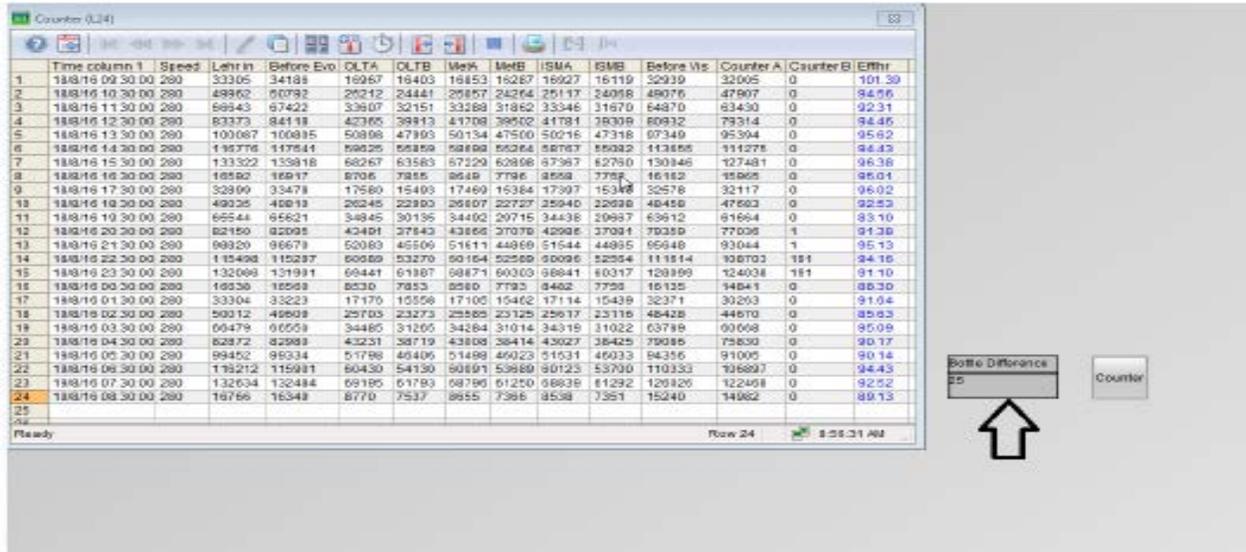


Figure 13: SCADA window for changing bottle rejection number

Figure 14 illustrates the SCADA window for central alarm, which is green due to no Hot End (HE) and Cold End (CE) Alarm is active. When RO pump Failure alarm works, then it shows red color in SCADA window, which makes the central alarm works. Figure 15 shows the output result. Figure 16 shows the central alarm works, when Evolution 5 alarm works.

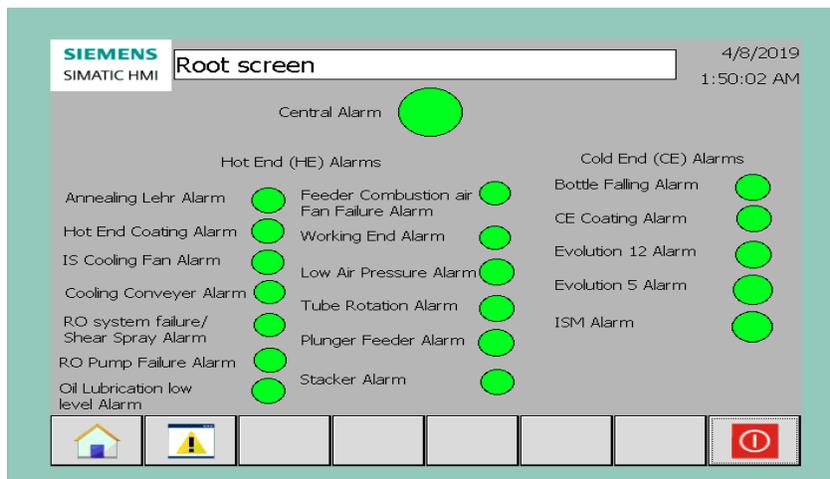


Figure 14: SCADA window for Central Alarm when there is no alarm

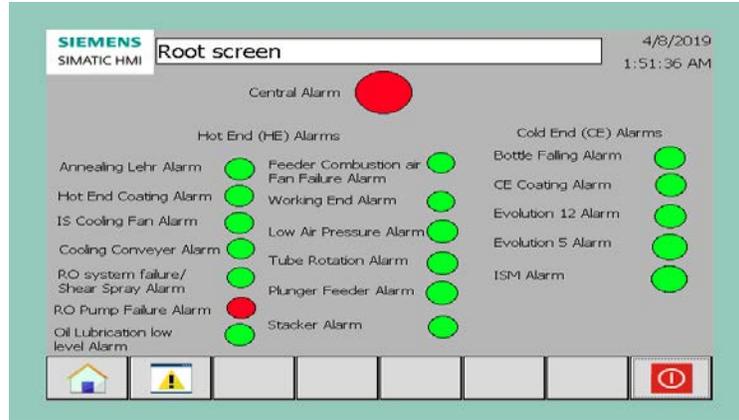


Figure 15: SCADA window for Central Alarm when RO Pump Failure Alarm works

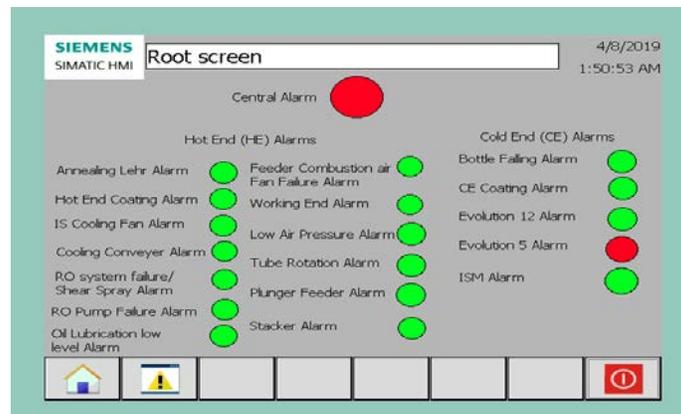


Figure 16: SCADA window for Central Alarm when Evolution 5 Alarm works

4. Conclusion

The work is carried out successfully in industry 'X'. In 3 months, it assumes that, the daily average production becomes 94%, whereas previously, it was only 87%. Hence, around 7% efficiency is being increased. About 3% loss is being minimized by protecting the falling glass bottles and 4% loss is being lessened by introducing alarms. This work can be used in any glass bottle manufacturing industries around the world.

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Biographies

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Abu Salman Shaikatis a Lecturer in Department of Mechatronics Engineering at the World University of Bangladesh, Dhaka, Bangladesh. He earned his B.Sc. in Electrical and Electronics Engineering from Ahsanullah University of Science and Technology, M.Eng. degree in Mechatronics Engineering from Asian Institute of Technology. He worked at Bangkok Glass Public Company Limited as a Production Engineer, AIT Extension, IT and Engineering Unit as a Service Provider and Dowla Consultants and Engineering Limited as an Electrical Design Engineer. His research interest includes Automation, Robotics, Artificial Intelligence, Product Design and Development, Control System, Image Processing and Deep Learning.

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