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Design and Control of Conveyors with Buffer System and Integrated Drilling using PLC

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Abstract

Conveyors are one of the most widely used means of moving the product almost everywhere. The result of design and control of conveyor with buffer system and integrated drilling system using PLC helps to solve the problem of overload of conveyor system and packaging unit, never effects the production and avoids the complete shutdown of the entire system. Conveyor system is designed such that the production rate has the maximum efficiency by keeping time constraints in mind. The shutdown problem being hindered due to malfunction of the conveyors is tackled using the buffer system and dual-speed conveyors. If one of the belt suffers from a malfunction the speed of the other belts increases so as to accommodate the extra incoming work pieces. The buffer conveyor belt gets activated when more than one output conveyor belts goes off. The intelligent distributer only distributes to running conveyors. It also provides enough time for the malfunctioned conveyors to get back to working condition without hindering the on-going process. Drilling process indicates one of the various processes that take place in the industry.

Keywords: *Buffer, production unit, packaging unit, shutdown, distributer, drilling*

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INTRODUCTION

Basically, there are two units in an industry, production unit and packaging unit. Production is continuous in any industry and is not stopped unless an emergency. Conveyor system is designed for traversal of products in a most efficient way. The problem occurs when the conveyor belts suffer a malfunction [1]. The production rate has to be maintained even in such situations because stopping the production is not desired. The problem of the drop in the production rate is solved using a buffer system and dual-speed conveyors. Buffer system gives time for the malfunctioned conveyor to get repaired and higher speed of conveyors compensates work piece. Driver circuit is designed [2] using TIP122 IC [3] such that, If one of the packaging lines goes down, the speed of the rest of the lines increases so as to accommodate the work pieces of the line which is down. If more than one line goes down, the speed of the other belts does not increase any more as the conveyor belts are already working at high speed, instead the buffer conveyor gets activated whose speed is slower compared to the other conveyors. Buffer keeps all the incoming work pieces in a loop that were originally meant for stopped packaging lines. Once the packaging belts get active entire system works normally.

SYSTEM CONTROLLING UNIT

System controlling unit being employed is a PLC [4, 5]. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory [4]. A PLC is an example of a real-time system that controls the entire process by switching relays [6]. Another unit is position control unit which controls the position of the distributer. This unit is a microcontroller [7] which is interfaced with PLC. It helps in distribution of the product to different packaging conveyors placed at different angles [8, 9].

MOTOR SPEED CONTROL UNIT

This is interfaced with PLC with amplified output voltage signal [10, 11]. Motor speed is controlled through driver circuit [12]. The dual

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speed DC motor driver circuit [2] is designed as per required speed [13]. This circuit drives the motor with constant rate when it is in normal state. In high speed state it helps in switching to high speed.

CONVEYOR SYSTEM

The conveyor system can be designed as per industry requirement. Conveyors can be of rubber, nylon etc. [8]. The conveyors are designed in such a way that they effectively carry product without any error and a similar conveyor is designed here.

BUFFER CONVEYOR

The buffer is an additional conveyor system; it can be of any size and shape as per requirement. The only purpose of buffer is that it helps in avoiding complete shutdown of the system and keeps the system continuous. This conveyor will come into picture when more than two conveyor belts get malfunctioned. If all three conveyors get malfunctioned then the distributer will only distribute to buffer conveyor until any of the three conveyors gets repaired. The speed of buffer is usually low compared to three working conveyors, the maximum time the buffer can keep the products is time required to repair any two malfunctioned conveyors.

PIVOT CHUTE

Pivot chute [8] is controlled by a microcontroller [7] which is interfaced with PLC. It is programmed in such a way that it equally distributes the product to the working conveyors [14, 12], as soon any one conveyor belt goes down it stops distributing the work pieces towards that malfunctioned conveyor belt, and starts distributing the work pieces only to the working output conveyor belts. When two conveyors get malfunctioned it distributes to the third conveyor and buffer. When all three conveyors fail, it will only distribute to buffer unless any conveyor gets repaired.

The whole system is intelligently designed such that the time taken by work piece to reach the pivot chute from the production unit is determined along with the maximum time taken by pivot chute to cover its longest distance between the packaging lines. Whenever the buffer gets full, the work piece from the buffer unit is dropped on the pivot chute such that it will not collide with the incoming work piece from the production unit [5], this will keep the pivot chute busy all the time and also it saves the extra time required to pass the work pieces to the packaging unit.

Table 1: *The Tests Performed on Conveyor Speed Under Different Situations.*

Test	Results	Remarks
No Malfunction	Rpm of motor 1=193 Rpm of motor 2=191 Rpm of motor 3=192	Conveyors moving at normal speed
Conveyor 1 is switched off	Rpm of motor 1=0 Rpm of motor 2=281 Rpm of motor 3=280	Speed of conveyor 2 and 3 increases, buffer line remains off
Conveyor 2 is switched off	Rpm of motor 1=279 Rpm of motor 2=0 Rpm of motor 3=282	Speed of conveyor 1 and 3 increases, buffer line remains off
Conveyor 3 is switched off	Rpm of motor 1=283 Rpm of motor 2=281 Rpm of motor 3=0	Speed of conveyor 1 and 2 increases, buffer line remains off
Conveyor 1 and 2 are switched off	Rpm of motor 1=0 Rpm of motor 2=0 Rpm of motor 3=282	Conveyor 3 remains at high speed. Speed does not increase. Buffer line switches on.
Conveyor 2 and 3 are switched off	Rpm of motor 1=279 Rpm of motor 2=0 Rpm of motor 3=0	Conveyor 1 remains at high speed. Speed does not increase Buffer line switches on.
Conveyor 1 and 3 are switched off	Rpm of motor 1=0 Rpm of motor 2=281 Rpm of motor 3=0	Conveyor 2 remains at high speed. Speed does not increase, buffer line switches on
Conveyor 1, 2 and 3 are switched off	Rpm of motor 1=0 Rpm of motor 2=0 Rpm of motor 3=0	All conveyors are off. Buffer line switches on

TESTS AND RESULTS

The following tests were performed on the system and the corresponding results were obtained. Table 1 shows the tests performed on conveyor speed under different situations. The above system designed is for one production line, three packaging lines and one buffer line. From the above results we found that if there is no malfunction in the packaging unit then all the three packaging conveyors run at normal specified speed but if any one conveyor fails to work then rest two conveyor speedup from their normal speed and if two conveyors fail then speed of third conveyor can't be increased anymore as we have certain limitations for increasing speed hence buffer gets activated. The pivot distributes to the buffer until any malfunctioned conveyor gets repaired. If all three packaging conveyors fail, the siren will be on.

CONCLUSION

The buffer system being designed is quite effective in maintaining the efficiency of the production rate. The speed of the buffer conveyor belt is kept slow so as to give maximum time possible for the repairing of the malfunctioned belts. But this time cannot be much as the production rate efficiency has to be maintained at an optimum level. This is achieved by using motors with high torque which rotate the conveyor belts at a particular speed. The state of the conveyor belts i.e. whether they are working or not is controlled by the PLC [14]. The drilling prototype is also controlled by PLC. Drilling unit uses sensor to sense the incoming work piece [12]. A photo reflective sensor is used to detect incoming work piece [15]. The designed buffer system increases the efficiency of the production rate. It also avoids the complete shutdown of the system. Overall it successfully achieves the aim of maintaining the production rate at an optimum level.

REFERENCES

1. Sarkar BN. *Fundamentals of Industrial Drives*. PHI Learning Pvt. Ltd; New Delhi. 2012.
2. Retrieved from http://www.talkingelectronics.com/projects/H-Bridge/H-Bridge-1.html
3. Retrieved from https://www.onsemi.com/pub/Collateral/TIP120-D.PDF
4. John Webb, Ronald Reis. *Programmable Logic Controllers-Principles and Application*. 5th Edn, USA, PHI Learning Pvt. Ltd. 2012.
5. Retrieved from https://w3.siemens.com/mcms/simatic-controller-software/en/ step7/simatic-s7-scl.
6. Retrieved from http://www.ti.com/lsds/ti/apps/automation/plc/overview.page
7. Muhammad Ali Mazidi, Janice Gillespie Mazidi, Mckinlay Rolin D. *The 8051 Microcontroller and Embedded Systems, using Assembly and C.* 2nd Edn. Pearson Education. 2008.
8. Mcguire Patrick M. *Conveyors-Application Selection and Integration*. CRC Press. 2009.
9. Jayadev TS. *Infrared Sensors-Detectors, Electronics and Signal Processing*. SPIE Publications. 1991.
10. Bakshi UA, Ghose AP, Bakshi AV. *Linear Integrated Circuits and Applications.* Technical Publications. 2010.
11. Biswanth Paul. *Industrial Electronics and Control.* 2nd Edn. PHI Learning Pvt. Ltd. 2009.
12. Bakshi UA, Godse AP. *Analog Electronic Circuits.* Technical Publications. 2014.
13. Retrieved from www.fairchildsemi.com
14. Rajput RK. *Robotics and Industrial Automation*. S. Chand Publications. 2008.
15. Retrieved from http://vtc.internshala.com/course/content.php?topic_id=15&module_id=2&course=robotics101&demo=true

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