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The Impact of Jams on the Vending Robot

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Abstract

This study aims to identify the causes of sensor jams and its impact on the operation of vending machines. The vending machine is a machine that automatically dispenses products such as drinks, tickets, sandwiches and biscuits, by inserting change or credit card into the machine. This technological feat is due to the advent of sensors. A sensor is a part of the measurement chain, it receives the quantity to be measured and provides information directly linked to this quantity. However, these vending robots are faced with malfunctions linked to sensor jams. The identification of the jam phenomenon was possible thanks to the inspection and monitoring of the various sensors installed on the vending robot. And Cadence software was used to model, control and locate the jammed sensor(s). The various tests were carried out by setting the robot in motion to better understand the causes of the phenomenon. The jam is therefore the phenomenon which triggers the sensors permanently, which causes the automatic vending robot to stop functioning. And this jam was due to the presence of water droplets on the sensor or dirt. This presence of water droplets on the sensor is linked to an increase in temperature. Controlling the temperature and locating the jammed sensor has made it possible to considerably reduce jamming and its harmful effects on the vending machine robot.

Keywords

Jam, Sensor, Dispenser Robot

1. Introduction

The remarkable evolution and popularization of the automation of industrial processes and the advances in innovative robotic systems (vending machines) in the industries represented by **Figure 1**, are due to the advent of sensors [1].

Dispensers are typically used in public and private spaces such as shopping malls, parks, commercial and government offices, and schools and along streets.

They appear in different forms and functions thanks to different types of sensors [2]. And sensors are a device allowing the state of an observed physical quantity to be transformed into a usable quantity [3]. Currently, there are three (3) types of sensors which are: analog sensors, digital sensors and logic sensors [4].

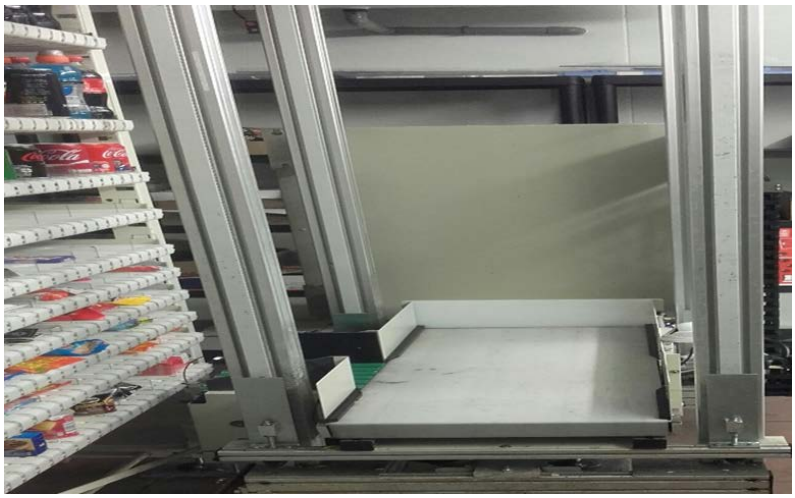

Figure 1. Vending machine robot.

However, vending machines often face jamming problems [5]. The jam is a robot malfunction, which permanently triggers the robot's extraction and detection sensor. This causes the entire system to shut down, resulting in a loss of store turnover.

The objective of this article is to understand the phenomenon of jamming of electronic sensors on the automatic dispensing robot, and to propose a concrete solution for this problem.

2. Methodology

To have better visibility on the jamming phenomena of electronic sensors in vending machine stores and offer an alternative to the problem, the various sensors installed on the vending machine robot have been inspected and controlled [6].

This monitoring operation is necessary to control the phenomenon of sensor jamming [7]. And the various tests were carried out by setting the robot in motion to better understand the causes of the phenomenon. Cadence software was used to model, control and locate the jammed sensor(s).

3. Result

The robot's extraction belts are controlled by an extraction sensor. The sensor and the receiver are distributed respectively on the two ends of the extraction strips. The sensor detects the products in the bays and orders the belts to extract them towards the pallet chain. Once arriving on the pallet chain, they are transported using two sensors and two receivers to the delivery belt to the end customer shown in **Figure 2**.

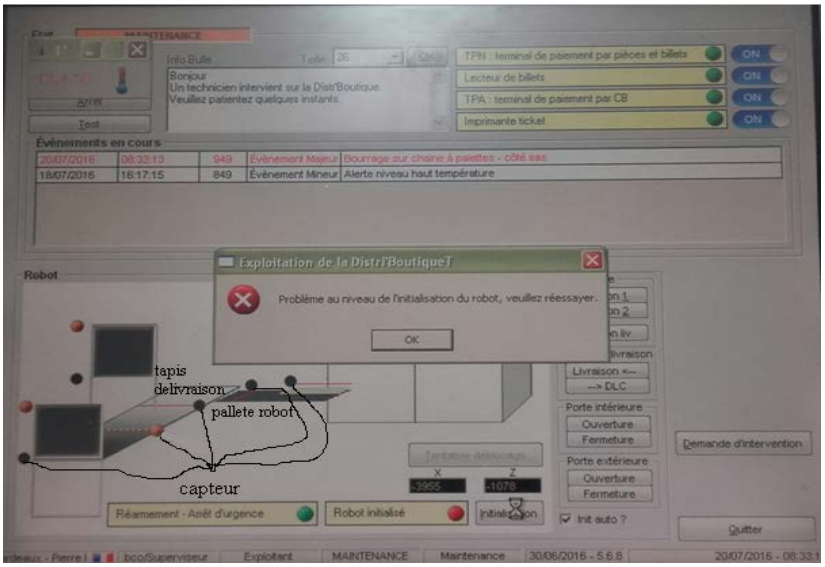

Figure 2. Robot simulated on cadence software.

Identifying the Jam Problem by Cadence Software

The correct operating state of each sensor is determined based on their colors (black and red). The black color means the state of proper functioning of the sensors and the red color means the state of malfunction of the sensors (jam). The simulation of the robot by the cadence software represented by Figure 2 made it possible to locate the jammed sensor.

The five (5) sensors linked to the pallet chain and the delivery belt are detection sensors. We clearly observe a malfunction linked to the fourth (4) sensor. This malfunction results in non-delivery of the product to the customer, because the fifth (5) sensor will only be triggered if the object captured by the fourth sensor is moving. Which causes the robot to stop. This type of malfunction is called pallet chain jam.

The chain-to-chain jam is mainly due to the presence of water droplets on the sensor or dirt. The sensor detects these water droplets and sends a signal to the receiver, which in turn reflects the signal back to the sensor permanently. This causes the robot to stop because the fifth extraction sensor cannot be triggered. The fifth sensor will only be triggered if the object captured by the fourth sensor is moving.

4. Discussion

Jams in a factory are expensive, increase downtime and sometimes result in additional expenses for equipment overhaul [8]. The "Choke Finder" system proposed by Samuel Jackson, 2018 edition made it possible to identify jams when they are about to occur, quickly pointing to the area where the problem appears, often making it possible to avoid at the same time the jam. Additionally, this affordable technology is easy to install and use [9]. But the "Choke Finder" system uses additional sensors to detect and prevent jams therefore increasing cost and does not

detect the presence of water droplets. The system proposed in this study uses highlights the causes of jams and rapid location of jam sensors but temperature control to avoid jamming of pallet chains. The "Choke Finder" system can be combined with the results of this study for better control of the jamming phenomenon.

5. Conclusion

The jam is the phenomenon that triggers the sensors permanently, which causes the automatic vending robot to stop functioning. It was due to the presence of water droplets on the sensor. And water droplets on the sensor were linked to an increase in temperature. Controlling the temperature and locating the jammed sensor has made it possible to considerably reduce jamming and its harmful effects on the vending machine robot.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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