Automatic Detection Machine on the OLP (Outer Link Plate) Cam Chain Using Camera Sensor and Programmable Logic Controller

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Abstract. In this paper, we have conducted research related to Automatic Detection Machine on the OLP (Outer Link Plate) Cam Chain. The research was carried out on a manufacturing company which is engaged in the manufacture of automotive components, namely: Drive Chain, Silent Chain, and Cam chain with various types. Automatic detection equipment against damage to OLP (Outer Link Plate) Cam chain is a tool that serves to perform automatic detection process in OLP cam chain. This tool is the result of improvement of the previous process is still done manually by an operator. This tool uses Keyence CV-2100 camera as the detection medium and PLC (Programmable Logic Controller) OMRON CPM1A-10CDR-A-V1 as the input-output control on the instrument. Results manufacture detector damage to OLP cam chain that is in terms of standardized average pitch chain - average of 6.27 mm ± 15μ. The number of chain NG (Not Good) caused by OLP are broken into decline. Previously on average 431 pieces per month to 379 per month.
Keywords: Camera sensor CV2100, PLC (Programmable Logic Controller), OLP (Outer Link Plate) Cam Chain

I. INTRODUCTION

PT. XYZ Indonesia is a company engaged in manufacturing, especially the manufacture of automotive components for motorcycles. Products made include Chain Drive Chain, Silent Chain, and Cam chain with various types.

With the increasing production from year to year, production activities have to be supported by means of automatic detection quality. So expect quality production efficiently maintained with time. PT. XYZ Indonesia is determined to make improvements in all areas including in terms of maintenance of quality. Section Quality Control of PT. XYZ has rejected the data chain cam chain during the month of November 2011 - January 2012 were found during visual inspection.

Based on the analysis, due to the OLP reject chain broken. OLP is 'broken' can occur by two causes, namely: OLP 'broken' because the pin pitch (the distance between two adjacent pin) and OLP are not centric pitch when assembling process, and OLP 'broken' due to her mouth like a chain in Figure 1 in down.

Figure 1. Chain with the distance between the two pins that creep of a standard size

Chain over the chain elongation because the material is not strong enough to withstand the pull of the engine but have not broken up preloading of the tensile test. To overcome these problems, we planned to construct automated inspection tool chain components one by one in the chain. It is expected that the addition of such a device is able to maintain the quality standards that the chain of production activities take place optimally.

Based on the above background, we conducted research to do the design and make the realization of the overall control system of automated damage detection tool chain elongation automatic outline. That is partly the workings of each component and how to program the camera settings and PLC CV-2100, so as to maintain the quality of the resulting chain.

Previously, we have researched about the application of sensors in automation control system by using PLC [1, 2, 3, 4, 5, 6, and 7].

II. DESIGN

A. Line Assembling Cam Chain

Assembling Line is one of the production line and the chain cam drive chain for two-wheeled vehicles in PT XYZ Indonesia. As already explained, Assembling Line is the line to assemble a product that is cam chain and drive chain with various types. Figure 2 shows the Assembling Process Flow cam chain cam chain in an assembly line.

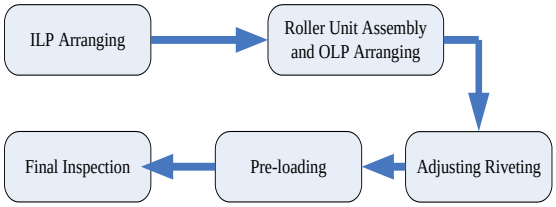


Figure 2. Assembling flow process of the cam chain in an assembly line LC

- OLP and ILP (Inner Link Plate) which has been separated began to be assembled. This process begins with the ILP attached to the pin and bush will form the RW (ILP arranging).
- ILP which has been incorporated coupled with OLP and roller (Roller Unit + Assembly + OLP arranging chain assembly).
- Components made with the pressing machine press against OLP order entry and installed as standard (adjusting riveting).
- Once inserted into the chain, and chain elongation testing machine according to the tolerance of preloading.
- Last detection of visually conducted by the operator.

B. Design of the Automatic Detection Equipment Damage on Cam Chain OLP

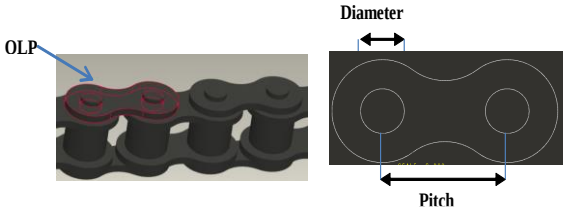
Automatic Detection Instrument OLP damage to the cam chain is an increase (improvement) is placed after the tensile test. These devices are placed before the product is checked manually by. It aims to facilitate the operator in detecting NG (Not Good) chain due to creep OLP difficult to detect visually by the operator. So expect part of a chain that can be directly detected NG repaired.

The concept of automatic detection equipment damage OLP cam chain is detecting a moving cam chain after the chain tensile test with the motor speed conveyor ± 3ms. This tool uses a vision sensor as media identification are detected and the region as a PLC control, programmed according to the desired working system and using fiber optic sensors as a trigger automatic camera.

C. Requirements Specifications

In the design of an automatic detector OLP damage to the cam chain, the manufacturing control system and PLC program must be tailored to the needs in the field or work area. Specifications are as follows:

- Speed camera captures images must be adjusted to the movement of the cam chain. The chain conveyor is driven by a motor in the engine that drives the chain preloading after the tensile test.
- The camera must be able to detect the small parts clearly. This is because the cam chain that has a hole diameter of OLP ± 3:22 mm. Figure 3 shows the OLP.



Gambar 3. OLP (Outer Link Plate)

- This tool should be able to detect when the chain moves continuously after tensile test to the examination process manually by the operator.
- Trigger the camera to make the tool works automatically, requires a fiber optic sensor that has adjustable startup speed with the speed and moving chain can work on small components.
- This tool requires a control system that the settings can not be changed by the operator in accordance with company standards such as PLC programs and camera settings.
- If there is a mistake in the work system repair parts or maintenance is easy to check and process parameters.
- This tool must be equipped with a selector button switches on-off the camera. Therefore, if it is necessary to turn off the camera while not disturbing the production process.

D. Design Concepts

Based on the system of work required, we have designed a concept of automatic control systems using camera vision sensor and PLC control system [8, 9, and 13]. Figure 4 shows the illustration concept control system design.

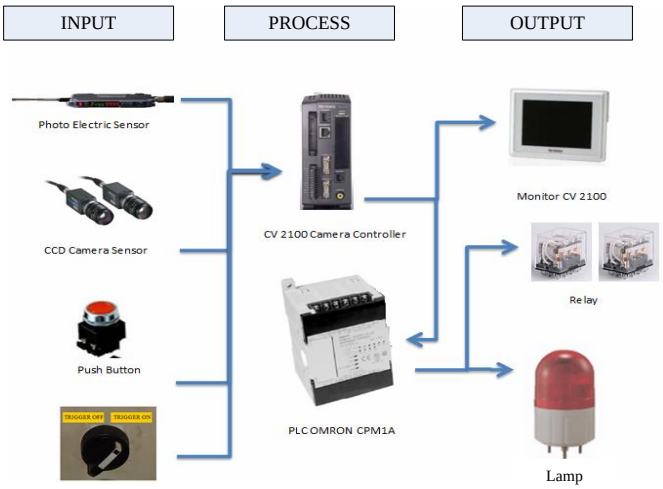


Figure 4. The concept a control system design

III. TESTING AND ANALYSIS

Program design automation control systems such as the detection of damage to the cam chain OLP. The explanation is as follows:

- Selector switch is provided to enable or disable the camera trigger which fiber optic sensors. If the camera trigger ON the active detection camera to capture images.
- Furthermore, when the motor rotates, causing the chain to move from place to preloading engine manual inspection. The movement sparked a chain of fiber optic sensors for active or non-active in sending a signal to the camera as a trigger. This is because fiber optic sensors placed in the gap between the ILP (inner link plate) adjacent to the bottom as shown in Figure 5 below. Fiber Optic Sensors use on dark mode, meaning the fiber optic will be ON and send a trigger signal when the position of Fiber Optic Sensors between ILP and glow Fiber Optic Sensor not on a chain. This is because when there is no light reflection due to no object blocking the sensor Fiber Optic Sensors dark on the inside position.

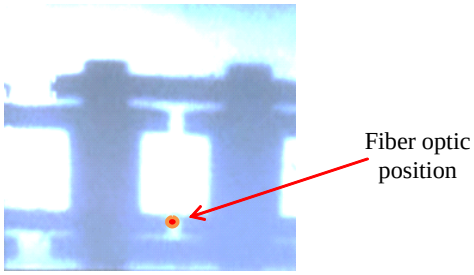


Figure 5. The position of fiber optic sensor

- Then when the Fiber Optic Sensor active then the camera will capture an image. The image is then processed by the vision controller CV2100. If in the process chain detected OK, the motor will keep spinning preloading move the chain to the manual inspection process. But when the chain was detected CV2100 monitor NG (Not Good) preloading the motor will stop right at the OLP detected NG. To reactivate the motor preloading, by pressing the reset button. Camera detection process will stop if the chain has reached the point of manual inspection, when the motor is not rotating preloading and when there is no power source.

A. Placement of Vision Sensor Keyence CV2100 on Line Assembling Cam chain

Vision sensors (Keyence CV2100) are placed on the LC2 line, after preloading process. After the tensile test chains, each chain components examined by the camera so that the chain can be seen directly on the camera's monitor situation more clearly [10, 11, and 12]. Figure 6 shows the mechanical design of the CV-020 camera placement.

Figure 6. Mechanical design on the CV-020 camera placement

To get a good imaging results chain, the exact distance required between the vision sensors with a chain so that the displayed image focus. Based on conditions on the ground, we made some experiments manually setting the distance between the vision sensors with chains and got quite a good distance in the image acquisition chain above preloading jig engine. Within a specified distance of the image acquisition of the chain can be clearly seen. The distance can be seen in Figure 7 below.

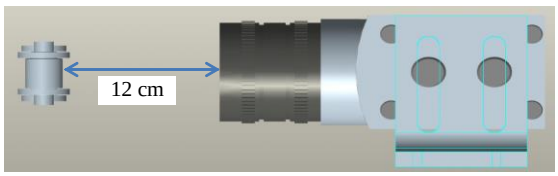


Figure 7. The distance between the vision sensors with a chain on preloading the engine

To see vision imaging sensors, then used a CRT (cathode ray tube). We use the monochrome CRT monitor, so the display image on the screen that looks nothing like the original color.

B. Testing on the position sensor vision CV-2100 in the LC assembling line 2

Testing was conducted on January 23, 2012 in line LC2 cam chain PT XYZ. Tests were carried out, namely the vision sensor placement Keyence CV-2100 in the assembling line LC2. Testing performed to determine whether the work preloading engine running without constraint or not. Table 1 shows testing the position of vision sensor.

C. Testing Image Chain by Vision Sensors

Testing was conducted on January 30, 2012 in PT XYZ. Table 2 shows the results of testing the image of the piston.

Table 1. Testing the position of vision sensor

No	Testing Parameter	Testing method	Results
1	Preloading conveyor motors can run	Manually	Good
2	Proximity sensor can detect a gap between two adjacent OLP	Manually	Good
3	Proximity sensors can provide input to the CV-2100 for triggering the camera so that the camera monitors display images every time a sensor detects a gap between two adjacent OLP.	Manually	Good

Table 2. The results of testing the image of the piston

No	Time	Location	Factors tested	Good	NG	Descriptions
1.	30 Januari 2012	Line LC2 PT XYZ	Stability of vision sensor image acquisition	√		Performed continuously with the same type of chain.

The definition of a stable image retrieval is image-making that continues to inspect parts of the chain that runs the chain inspection area between ILP (Inner Link Plate) chain as shown in Figure 8 below.

Figure 8. Chain inspection area whenever the camera that captures the image

IV. CONCLUSION

In this paper, we have discussed the design and testing of Automatic Detection Machine on the OLP (Outer Link Plate) Cam Chain Using Camera Sensor Keyence CV2100 and Programmable Logic Controller. Based on testing, the results of the correlation measurement sensors can be used continuously. Reliability of vision sensor, image acquisition is limited in terms of the desired area. We have made additional vision sensor cover Keyence CV-2100 to avoid the light which interfere with the performance of fiber optic sensors are used as trigger the camera and also the performance of the camera CV-2100. Results manufacture detector damage to OLP cam chain that is in terms of standardized average pitch chain - average of 6.27 mm ± 15µ. The number of chain NG (Not Good) caused by OLP are broken into decline. Previously on average 431 pieces per month to 379 per month.

V. REFERENCES

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