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## Design Control Systems to Detect Applied Grease Machine Based on Programmable Logic Controller in Manufacturing Industry

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# Design Control Systems to Detect Applied Grease Machine Based on Programmable Logic Controller in Manufacturing Industry

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**Abstract.** This research was conducted in a company engaged in the manufacture of Automotive Spare Parts, especially the manufacture of automotive components in particular four wheels. One of the products manufactured by this company is a door lock manufactured product for a variety of models and brands of four-wheeled vehicles. Applied grease machine is one of many machines which is used to apply some grease to the parts of door lock product in production line. This machine is developed in a manufacturing Industry in Indonesia. This apply grease machine only uses one process mechanism that is applying some grease to selected part. In this process, it is still general, that means there is no different between one product and the other product in applying grease process, and it causes waste of the grease, because each product has differential of grease portion. Base on the condition, Equipment Development Section has an order to make a new machine, the machine detects apply grease machine that could detect the product at the first step, to avoid some mistake and give different portion of grease to each other model. This machine is using PLC (Programmable Logic Controller) MITSUBISHI FX3U as main control system. By using this machine, production process can be processed more effectively in case of detecting product and applying grease to each other product model because of part product detector sensors, to avoid human error and decrease costumer claim to 0% in production line ASDL09.

## 1. Introduction

This research was conducted in a company engaged in the manufacture of Automotive Spare Parts, especially the manufacture of automotive components in particular four wheels. This company produces Clutch Cover, Clutch Disk, Door locks, Door Latch, Door Check, Door Hinge, Door Frame, Window Regulators, Hood Latch, inside or outside handle, Intake Manifold and others.

One of the products manufactured by this company is a door lock manufactured product for a variety of models and brands of four-wheeled vehicles. Each model has some products manufactured product parts are assembled so that it becomes a product door lock. Because the door lock manufactured products for a variety of models and brands of vehicles, then each product model has some differences due to the demand of the costumer.

In the process of making the product door lock consists of several production lines ranging from the installation of parts of the product until the final inspection of the product. One of the processes that



exist in the production line is the process of providing grease gets product door lock. Grease granting process is very simple, namely by spraying grease gets products through copper tubing that has been set up such that it can squirt grease into specific points on the product door lock.

This research did in Equipment Development in engineering department. Applying grease machine is used for the process of grease on parts of certain processed products from the production line before. This machine is made to be able to distinguish one product and the other for their differences for each product door lock. This machine is equipped with detection equipment parts and products already have special valves for each of its slang grease. Interest additional detection tools in addition to detecting the product section, also serves to detect if the wrong part plug on the product door lock, and also determine the parts that will be given special grease. The end goal is to prevent human error and the customer claim for their forgetfulness or error during installation of parts of the product and more effective in the use of grease.

The grease application process is done by spraying grease principle similar to the previous engine. The process consists of two processes, namely the detection process and the processes that grease application. Fill process is very different to previous machine that does the application of grease without detection and spraying grease is general. Because of differences with the previous machine, this machine is equipped with a more complete system to support the detection and management of grease of a special portion.

To make effective use of the grease and prevents it from lack of parts on the product, it takes a machine that can perform special grease application and detection before the process. Our research focused on design control systems to detect applied grease machine so it can detect and display the indicators of product parts, undetected and over detect so as to eliminate the potential for human error and make the process of applying grease to each model door lock product as needed. G. Valencia-Palomo et al. have design an auto-tuned predictive control based on minimal plant information using PLCs [1]. While Buhner et al. have discussed about changeability of manufacturing automation systems using an Orchastration Engine for PLCs. In our previous researches [2, 3, 4, 5, 6, 7, and 8], we have designed and analysis the various sensor applications on the machine automation PLC-based in manufacturing industry, and also using the HMI (Human Machine Interface).

## 2. Methods

### 2.1. *Introducing Door Lock*

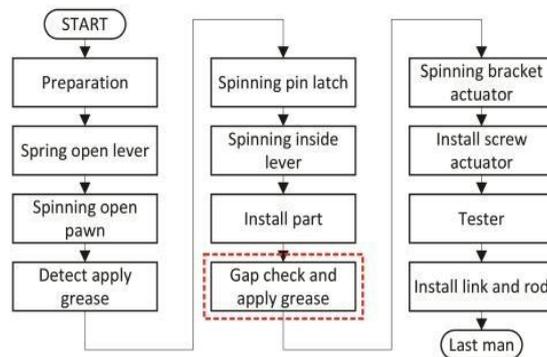
Door lock is one component of security in four-wheeled vehicles or more. Door lock is made of a combination of metal and plastic material that is located on the body of car or more precisely located on the doors of the vehicle. Figure 1 shows door lock product.



**Figure 1.** Door lock product

### 2.2. *Line ASDL09*

Line ASDL09 or Assembly Door lock 09 consists of 13 posts. On the production line manufactures door lock with a model process d9 \* b, \* d d4, d8 \* d and some other models. Figure 2 shows ASDL09 flow process line.



**Figure 2.** ASDL09 flow process line

Point the problems that exist on the machine:

- Valve grease, must be setup again when replacement of the product model.
- Indicators yet if any part of the product is not installed or installed incorrectly.

### 2.3. Detect Apply Grease K21 Machine

Machines detect apply grease k21 is one of the supporters of the engine production line ASDL (Assembly door lock) 09 which serves to detect the parts that exist in the product door lock and give grease on the parts that have been determined.

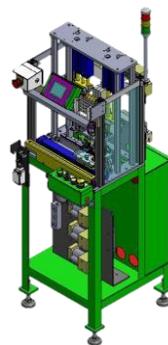
### 2.4. Detect Apply Grease K21 Machine Specification

Based on existing data on the division of equipment development, obtained detects engine specifications apply grease k21 as follows:

- Machine dimension: 1398 mm x 450 mm x 510 mm
- Input Voltage: 220 VAC
- Control Voltage: 24 VDC
- Air Consumption: 0.5 Pa

### 2.5. Detect Apply Grease Machine Concept

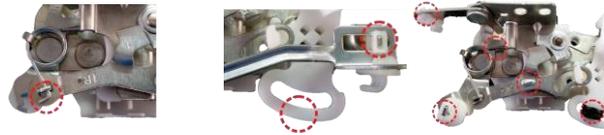
Figure 3 shows detect applied Grease Machine:



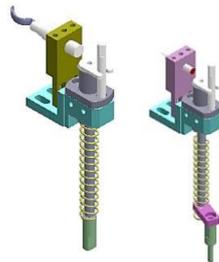
**Figure 3.** Detect applied Grease Machine

### 2.6. Detection Tool in The Machine

Figure 4 and Figure 5 show product part that will detected and product detector.



**Figure 4.** Product part that will be detected



**Figure 5.** Product detector

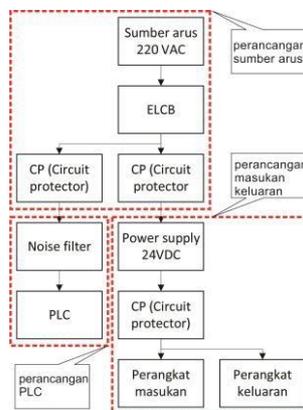
In the detector, using two basic concepts for the detection products. First, the detection devices to touch the products that have been determined to be detected. Second, the metal ring will be pushed upwards if touching parts are detected and proximity sensor will send a signal if the ring on proximity sensing area.

*2.7. Detect Apply Grease K21 Machine Process*

The basic concept of the working order applies grease k21 detect machine consists of three processes, namely the detection, pan or move the position and application of grease. In the first or the detection process, the existing sections on product door lock is detected in accordance with section prearranged. The second process is to move the position of detective position to the position of giving grease. The third process, the application process is grease.

*2.8. Electric Design*

The design of the electrical machine control systems detects apply grease is divided into four parts, the design of the current source, the input device design, PLC design, and design output device. Figure 6 shows electric design.



**Figure 6.** Electric design

- Input Device. Machines detect k21 apply grease has how many kinds of input tools that serves to provide a signal to the PLC that will be processed and produce output.
- Processing Device. Machines detect apply grease k21 has process device is PLC. PLC functions to process data input from input device into the desired output data. In addition to processing the input data, it also serves as a data storage medium of the process of teaching the machine.
- Monitoring Device. Machines detect apply grease k21 has a monitoring device that serves as a monitoring process of the machine is called the HMI. Apart from the main function as a monitoring tool, the device also serves as input device to the PLC.
- Output Device. Machines detect apply grease k21 has some output device that serves as a driver for the production process and other functions, namely as an indicator. The output device will be activated in accordance with the data processed have been processed on the PLC.
- Actuator. Actuator device consists of two kinds, namely the cylinder and fluid dispenser.

### 3. Design and Testing

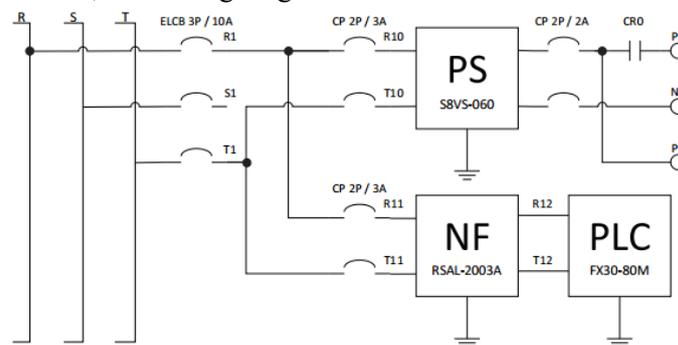
#### 3.1. Control System

Manufacture of machine control systems detect apply grease k21 is divided into two, namely the manufacture of electrical and programming.

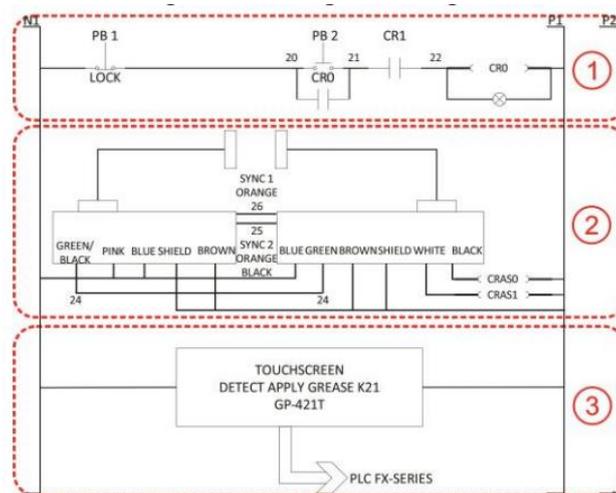
#### 3.2. Electricity Process

In making this includes the electrical wiring of all components that have been designed. Electrical components designed include the components on the current source, plc component, component input and output components.

- Power. Figure 7 shows main power diagram and PLC. Figure 8 show preparation diagram, wiring diagram of Safety Sensor, and wiring diagram of HMI.



**Figure 7.** Main power diagram and PLC



**Figure 8.** (1) preparation diagram (2) wiring diagram of Safety Sensor (3) wiring diagram of HMI

- Preparation
- Safety sensor
- HMI
- Input Output

#### Information:

- PS DT: proximity sensor detects
- PS BN: proximity sensor biner
- RS DT: reed switch detects
- RS GR: reed switch grease
- RS LP: reed switch left position
- RS RP: reed switch right position

The input device consists of a total of 35 devices. While the output device is composed of a total of 20 devices. Pneumatic. Here is a diagram of the pneumatic actuators and pneumatic for fluid dispenser (IH).

- Main Control Panel
- Control Box. Control box consists of physical keys most often used. Existing devices on the control box is a selector button and a buzzer.

Start switch is a modification of components made of the limit switch (number 2), and added lever (number 1) in order to suppress the limit switches by moving the lever left. Limit switch used is Omron WLD28-LE.

### 3.3. Design of Programming

- Teaching sensor program. Teaching in question is doing any setup detection sensors that should and should not detect the product for each production model. Here is how to step out of teaching ranging from the determination of the detection tool which will detect how initialization coil into the data memory, the addition of additional data and determination of the grease valve to be active.
- Automatization program. Once the teaching process is complete, the program will then be displayed determination program where the models that will be executed, how the process of detecting when the program auto mode and how the subsequent execution until the process of grease.
- Product sensors indicator. The next program will be shown how to process the product detection indicators may appear on page notification on the HMI. Starting with the delivery of benchmark data to program comparable data and the comparison between the data obtained at the time of

detection of the product, so it can display on the HMI. Figure 9 shows the display of product detection indicator.



**Figure 9.** The display of product detection indicator

### 3.4. Testing

The control system has been created and all input devices have been installed and output should pass testing phase. Testing is done to prevent the failure of a device that has been installed on the PLC.

- Input device test. Testing of PLC input in two ways, namely by connecting a PLC with the computer, and then see the direct working contact on the ladder diagrams that exist on the computer display. Second by looking directly into the PLC, which saw the existing input indicator light on the PLC.
- Output device test. Testing of output devices performed similarly to the process output, by monitoring via PLC, namely to create a ladder program testing output and through indicators on the PLC.
- Testing the program detect. Tests conducted to determine whether the program has successfully detected the product and is in conformity with the teaching program is conducted.
- Undetected programme test. Tests conducted to determine indicators of parts of products that are not detected or parts of products that should be on the product, but no or installed incorrectly.
- Over detect programme test. The test is performed to determine whether the indicator should not detect the products are in accordance with the work according to the needs. Over Detect is a condition where a part of a product that should not be attached or mounted to other parts of the products that come installed or installed incorrectly.
- Working system test. Testing systems work is performed to determine whether the system is already running the machine working properly and in accordance with the working order predetermined or desired.

### 3.5. Analysis results

After testing, the next step is to see the results that arise from the new machine, whether the outcome was consistent with the previously planned. Machines detect apply grease made to replace the old machine apply grease. Analysis of the results of the trial process is needed to ensure return if all the machines are appropriate. Apply grease k21 detect engine is equipped with detection devices and indicator detection during the detection process. To avoid human error during installation piece or part products, namely forgotten or incorrectly installed. In addition to prevent human error, detection is also useful as a means of deciding where the grease valve that will be active at the time of grease in the respective product model.

#### 4. Conclusion

In this paper, we have discussed about design control systems to detect applied grease machine based on Programmable Logic Controller in manufacturing Industry. Designing of detect applied grease k21 machine uses Mitsubishi PLC FX3U-80M is communicating with Pro-Face HMI as a device process, control, and monitoring. The machine is equipped with detection equipment products that can be setup for each model and the results of detection is used for checking parts that product has been installed and used as information for the next process is apply grease. The function of the machine becomes more specific during the process of administration or application of grease that already are specific to each model. When the process of replacement of the product model no longer need to manually rotate the tap grease, just by changing the card program and pressing the designated button. In addition, the suggestion for the future research is applying SCADA system for the machine, and puts the information directly into the Andon. It will be more effectively because the process and the results can be monitored easily without having to go to the machine directly.

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