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IMPLEMENTATION OF PLC SYSTEM IN FISH FEEDING RATE DETERMINATION

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ABSTRACT

This study is about the development of a control system design using Programmable Logic Controller (PLC) system which gives food to the fish with a blower method. To perform fish feeding system automatically the control system will include PLC system, touch screen, emergency button, terminal block, speed controller, relay NY-2N, and power supply 240V. The component of the input systems are autonics sensor includes counter clockwise sensor, clockwise sensor and distance pulse sensor. While the components of the output systems are forward/reverse motor and blower. The overall system and its components are tested with the reliability test to check the components' performance. The result of reliability system shows that all LED components emits light signal when both direct connection circuit and PLC system is interfaced. The feeding time need to be increased as the fish weight increased.

INTRODUCTION

A study on the need to improve of fish feeding system is seen as an important factor which contributes to aquaculture field. Therefore fish feeding system on the actual pond has potential to be developed. The fish feeding system is divided into three components, which consists of PLC system, Rail system and food spreading machine. The PLC system is used to control the food spreading machine system automatically. Based on the research in the past, there is a number of difficulties identified. For example feeding fish manually by fish farmers in the pond is not consistent; the quantity of food is given inaccurately to the fish which contribute to the problem of fish deceased. Therefore a PLC system for feeding rate is designed to resolve the problem occurs. The PLC system needs one operator to put the fish food into the hooper of the fish feeding machine. As the result, this project is implemented into the real environment and the effectiveness of this system is slightly high compared to the manual system as it can reduce energy usage and at the same time the fish are consistently feed at the assigned time.

The CPU is able to conduct a variety of operations. It accepts input data from multiple sensors and then carry out the processing based on a program stored in memory. Then it sends the appropriate output signals to control devices required. A direct current power source is needed to produce a low-level voltage used by the CPU input and output modules. This power supply may be in the same house with a CPU unit or units that are dependent on other manufacturing PLC system, [2]. Most of the CPU for this PLC have battery source for power storage, the battery source will be used in case of failure at the main power. The PLC used for this system is OMRON SYSMAC CP1L-L20DT-D. OMRON SYSMAC CP1L-L20DT-D is industrial PLC which is used for automatic controlling system. The CPU for this PLC is microcontroller 320-bit which contains 32K

chip data memory. CP1L support 162 instruction (14 basic and 148 special instructions) and the I/O possess 256 capacity storage which depend on the requirement system. In this study a control system for fish feeding machine are designed to meet the requirement of quantity of food. For this purposes, PLC system, rail system and food spreading machine to be use in the actual pond.

METHODOLOGY

All components need to be identified and must compatible with PLC unit. The next step is to determine the movement needed of the fish feeding machine in order to design the control system. After Ladder Diagram is built by using CX-programmer software, it will be transferred to the output of the PLC, then the connection must be inspect at the input and output of the device before it ready to be use. The designation of the system can be used if once the system runs smoothly**.** All components are identified as shown in Figure 2 to Figure 6 and the components applied in this study are as follow:

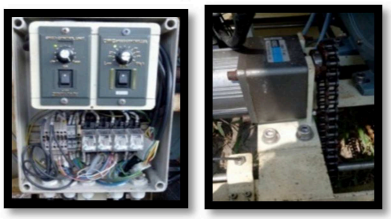
i. PLC type OMRON SYSMAC CP1L-L20DT-D test
   - Input port and output port
   - Input and output voltage

ii. Relay NY-2N test

iii. Motor and head gear with speed controller motor test

iv. Autonics sensor test

Figure 2: Direct Connection of Components



(a) (b)

Figure 4:(a) *Speed Controller* to *Relays Connection* (b) motor and gear

Figure 3: OMRON SYSMAC CP1L PLC

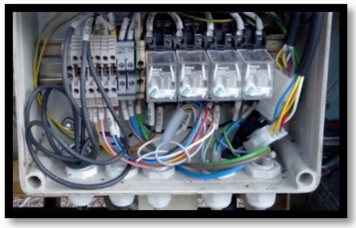


Figure 5: Connection of *Relay* in electrical circuit

Figure 6: Autonics sensor

Each component used requires an early inspection, it is very important to inspect the component by following certain steps. If one of the components used is damaged, it will force to stop the time to wiring. The components that involved in the damage are not easy to be identified if there is no early inspection. Based on the test conducted, the selection of component that working properly can be use for wiring in control system. The voltage at the output component cannot be higher than the voltage output on the PLC. If occurs, the probability of the component will not function properly and might cannot be use. The Motor and Blower voltages cannot be higher than the voltage output of the PLC.

RESULT AND DISCUSSION

Reliability Test Component Analysis

The result of the reliability system shows that the entire LED light will be on when the direct circuit connection transferred to the PLC. All the components are working properly after the examination run to the whole system. The PLC voltage requirement is 24V while the requirement voltage for the motor and blower are 240V.

1. Analysis of component reliability – to ensure the functionality of input and output. The sign of √ indicates the system or components are working well.
2. Analysis test of relay NY-2N - to determine the ability and functionality of relay NY-2N when it is connected to forward/reverse motor, screw feeder motor and blower
3. Analysis for motor testing and head gear with speed controller motor -the motor and head gear is tested simultaneously with the speed controller motor. Speed controller motor connected to relay in order to gain 240V voltage.
4. Analysis Autonics Sensor Test - "touch testing" is done to CW sensor and CCW sensor, while the distance pulse is tested by determine the movement from the pitch gear installed to the shaft, which is connected to the motor. All results as depicted in **Table 1** to **Table 5.**

Table 1: Examination data for voltage value at the input and output port

Input *(address)*	Voltage (V)	Ouput *(address)*	Voltage (V)	Result
0.00	24	100.00	22.9	
0.01	24	100.01	22.5	
0.02	24	100.02	22.3	
0.03	24	100.03	23.4	
0.04	24	100.04	22.6	
0.05	24	100.05	22.8	
0.06	24	100.06	23.9	
0.07	24	100.07	22.5	

Table 2: Examination result for relay NY-2N

Component	Controller	Result
Motor *forward/Reverse*	*CW Travel Relay*	
	CCW Travel Relay	
Motor *screw feeder*	*Screw Feeder Relay*	
Blower	*Blower Relay*	
	CCW Travel Relay	

Table 3: Examination for motor and head gear tested with speed controller motor

Motor and gear head	Relay	Speed Controller	High Speed	Low Speed
Forward/Reverse Motor	CCW Relay	**1**		
	CW Relay			
Screw feeder Motor	Screw feeder Relay	**2**		

Table 4: Examination result for autonics sensor

Autonics Sensor	Touch Test	Distance Test
CW sensor		-
CCW sensor		-
Distance pulse sensor		

Analysis for time testing for the Feed Rate according to Fish Feed Schedule

The time testing for feed rate is based on the blower and screw feeder motor, the process of the feeder is using blower method. This testing is to determine the most appropriate time for the feed rates to be given according with the rates specified. The time is set at the program and can be manipulated manually.

1. Calculation of feed allowance for red tilapia fish according to specific weight
   Average fish weight = x (gram)
   Total fish = y (fish)

2. Feeding rate of 3% of the fish body weight
   Total weight fish x (gram) X y (fish) = XY kilogram
   XY kilogram x 0.03 = 0.03XY gram

3. Daily feeding rate

   Total daily feed = 0.03XY gram
   How many meals a day = N

$$\frac{\text{total daily feed}}{\text{how many meal a day}} = \frac{0.03XY}{N} = \text{M gram}$$

Testing process is performed after the program at the PLC can be transferred and working properly. Time will be set at the program and will be change during the testing process.The test is carried out to determine the most accurate feed rate time according to the actual

Table 5: Fish feed rate and feeding time

Age (week)	Fish Weight (g)	Total Fish	Feeding time perday	One feed time (gram)	Total Feeding time (s)
<1	5	1200	4	187.5	33.7
Stage 1 (>1)	15	976	4	146.7	30
Stage 2(4^{th})	41.4	976	3	400	50
Stage 3(6^{th})	72	974	3	700	100
Stage 4(8^{th})	123.4	972	3	1190	200

Feeding Time was set using touch screen which interfaced with PLC unit. From the **Table 5**, the fish weight has increased almost twice in eight week of growth using this feeding system. In determining one time feed for approximate 1000 fish, the calculation will consider number of fish and times feed daily.

CONCLUSION

The entire system have been tested with reliability test system, reliability test component and time testing for the feed rate according to fish feed schedule. The result of reliability system shows all components are working properly when both direct connection circuit and PLC system is interfaced. The feeding time need to be increased twice as the fish weight increased.

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