



7. Discussion

When start button is push, coil 1(C1) will be energize. Then the contactor 1 will become normally close and allow water flow into the valve 5 from the main water inlet. When the valve 5 allows water to flow in, the pump 1 will on and start to pump water. The opening of valve 5 will allows the water pass through valves 3 and flows into the filter. So, in the filter, the water will going through filtering process.

After going through filtering process, the water now will pass through valves 4. Then the valve from the reservoir tank which is valve 8 will open, and allow water to flow into the reservoir tank. When the valve 8 is opened, the aerorator motor will also on and start pumping oxygen (O₂) into the tank. At the same time, the valve 8 will also activated the TIM000, and the time will start count down for every 60seconds. For every 60 seconds, the NF tank will start pumping Nitride Bacteria to the reservoir tank. In the same

time, the UV light systems will on and start to kill the germ in the water. This ensures that the water is in good condition for the aqua life.

Then, the water will flow through the temperature regulator to maintain the temperature of water for aqua life. Pump 4 will on to allow the temperature regulate process. Meanwhile, pump 2 is ON all the time, to pumps water from the reservoir tank to the aquarium. The pump 2 is activated by the contactor (C1). When water pump 2 is on, the valve 12 is open and allows water to flow to the valve 1. Then, valve 1 will be open too and allow water to flow into the aquarium.

There are 2 sensors in the aquarium to detect the water level in the aquarium. When the sensor sense nothing, that mean the water for the aquarium is not enough. Both pump 2 and pump 3 will on to allow pumping more water from the reservoir tank to the aquarium. When the sensor sense only

level sensor 2, the pump 2 and 3 are still on to allow more water will pump and flow to the aquarium. The pump 3 will only off when the water level reach sensor 1, which means the water in the aquarium, is enough. When 2 sensors are sense, it will allowed valve 2 to open and start repeating the process from the beginning until the stop button is pressed.

7.1 Filtering process:

Filtration is the advanced clearing procedure, consisting of water’s passing through a porous material that has a certain granulometry named filter layer. This is used for retention of the natural suspended particles or previous coagulated particles. For filtering process, there are few valves that control the function of the filter. There are valve 3, 4,5,6,7 and pump 1. The coil is activated the contactor and allow valve 5 to open. Then, the pump 1 is on and starts to pump water. Valve 3 and valve 4 are control the water to flow in or out for the filter. There is a control button 1 for cleaning process too. When the button 1 is push, the valve 3 and valve 4 will close immediately. Then the valve 6 will be open and allow water to flow into the filter for cleaning. The water will drained out from valve 7 when the cleaning process is on.

Table 2: Filtering Process Condition

	Button 1	Valve 3	Valve 4	Valve 5	Valve 6	Valve 7
Water flowing process	OFF	open	open	open	close	close
Cleaning process	ON	close	close	close	open	open

7.2 PH Regulating Process

The PH regulating process is happened in the reservoir tank. When valve 8 is opened, the aerorator motor will also on and starts fusing oxygen (O₂) into the tank. In the reservoir tank, it has a PH sensor (sensor 3) that senses the PH value of the water. When the PH value of water less than 7, the CO₂ tank will on, and start pump carbon dioxide to regulate the PH value. The net result of adding a small quantity of carbon dioxide to water is to reduce the concentration of dissolved carbonate ion and increased by carbonate ion through the reaction: CO₂ + H₂O + CO₃²⁻ → 2HCO₃⁻. The sensor will check the PH value of water for every 30 seconds. When the PH above 7, the aerorator will pumps in oxygen to regulate it back to normal PH value.

Table 3: PH regulating process condition

PH value	Action
<7	Adding CO ₂
>7	Adding O ₂

7.3 NF (Nitrification) and UV Process

The nitrification and UV process are important process to improve the quality of water in the reservoir tank. To shorten the time needed for the establishment of the nitrification process, it is necessary to seed nitrifying bacteria inoculums to the aqua environment. The aqua life is more comfortable after adding nitrifying bacteria in the water. The process will repeat for every 30 second that control by timer (TIM000). Meanwhile, the UV process can kill the unwanted germs in the water to improve water

quality. This process will also on for every 30 second in the reservoir tank.

Table 4: NF (Nitrification) and UV process condition

NF process	ON
UV process	ON

(For every 30 seconds)

7.4 Temperature Regulation Process

For the temperature regulator, inside contain temperature regulation chamber to regulate the temperature to aquarium. The pump 4 is always on to ensure the temperature regulator function well with the continuous flow of water. The temperature regulator is on when the start button is push, and the coil (C1) is energize to allow contactor (C1) become normally close and allow voltage pass through.

Table 5: Temperature regulation process condition.

Condition of Start button	Temperature regulator
ON	ON
OFF	OFF

7.5 Aquarium (Water Filling Process)

After passing through the entire valves and some process, the water is needed to fill the aquarium. There are 2 pumps that control the flow rate of the water from the reservoir tank to the aquarium. When the sensor sense nothing, that mean the water for the aquarium is not enough. Both pump 2 and pump 3 will on to allow pumping more water from the reservoir tank to the aquarium. Both pump 2 and 3 on together can increase the water flow rate to the aquarium. When the sensor sense only level sensor 2, the pump 2 and 3 are still on to allow more water will pump and flow to the aquarium. The pump 3 will only off when the water level reach sensor 1, which means the water in the aquarium, is enough.

Table 6: The condition for the pump 2 and 3 on/off:

Sensor 1	Sensor 2	Pump 2	Pump 3
0	0	ON	ON
1	1	ON	OFF
0	1	ON	ON
1	0	-	-

7.6 Drainage Process

There are 3 drainage valves for the system. There are valve 7, 10 and 13. For the reservoir and the aquarium, it will automatically drain water from the valves 10 and 13 if overflow happen. While, the drainage for valve 7 are use when the cleaning process is happened.

8. Conclusion

In a nutshell, this paper presents the system and controller design of the aquarium management system controlled via PLC controller. The function of PLC in our designed system is used for controlling input and output valve, operation of pump, filter cleaning and water treatment which comprise of nitrification, UV disinfection, pH leveling and as well as temperature regulation. With the use of PLC in the system, we can minimize the human errors in the water management

system. PLC provides the best practical solution to the aquatic industry.

9. Acknowledgements

The author wants to express appreciation to Unmanned and Autonomous Research Group (UAIR), Centre of Excellence in Robotics and Industrial Automation (CERIA) and Universiti Teknikal Malaysia Melaka (UTeM) for sponsoring this project.

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