IoT based Two Levels Feeding System for Koi Fish Pond

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Abstract. Raising fish in a pond at home can be a hobby and add to the aesthetic value of the owner's residence. Sometimes people doesn't aware with the routine of feeding due to busy life that takes up a lot of time. The system that is designed in this work will help people who raise fish to monitor and control feeding activity and the number of pellets to be given remotely. The App Inventor is used to control and monitor an Internet of Things (IoT) based system. The system can display the pellets weight from the load cell sensor measurements on the container. The system is able to send notification if the feed weight is less than 300 grams. Users can choose four feeding settings, namely: S size, M size, L size, and customize. The servo motor will open the valve on the feeder and container containing pellets. The results of this work indicate that the two level feeding system for koi fish is working well. Sending and receiving data from and the webserver works well. The weight that is read by the load cell is displayed correctly.

1. Introduction

Raising fish in a pond at home can be a hobby or add to the aesthetic value of the residence owner. Sometimes people with a lot of daily routines ignore the food feeding activity to their fish. Feeding koi fish needs to be done carefully, especially in providing the portion or amount of the pellets to be given [1]-[5]. The impact of overfeeding causes koi fish release more manure pile. This will degrade the quality of the fish pond water.

Weku et al. (2015) designed Automatic Fish Feeding Device using Microcontroller [6]. This device will automatically feed the fish in certain time according programmed schedule with predetermined amount of pellets. When feeding process is done and the pellets container is empty, the device will send information via Short Message Service (SMS).

Another work has been done by Firdaus et al (2016), He made automatic fish feeding and pH controlling device [7]. This device is equipped with Liquid Crystal Display (LCD) to display feeding time schedule and pH index at that time.

In this research, a control device designed to use remote control through the IoT platform application on an Android based smartphone, which is App Inventor that is managed by MIT (Massachusetts Institute of Technology) [8]. This device allows fish feeding process is done according to predetermined standard portions regularly or customize timing. There are two pellets containers and the opening of each container outlet is controlled by using servo motors. The system provides 4 feeding options with different size of pellets that are size S, M, L, and customize size. One container has bigger size than the other so that it can be filled with more pellets. Therefore, this system is called 2 levels system.

When the small container (fish pond pellet feeder) run out of pellet, the bigger container will supply more pellets. Containers are equipped with a load cell sensor for measuring the weight of the pellets, as well as monitoring the amount of remaining available pellets. If the pellets in the big container less than 300 grams, sensor subsystem will send information to smartphone to warn the user anywhere and anytime.

2. System Model

System model that is used in this research is depicted in Figure 1. Arduino Mega is used as a microcontroller and connected with ESP8266 Wi-Fi module using serial communication to send and receive data [9]-[12]. The ESP8266 Wi-Fi module is an additional module in order to connect the sub system to the internet and send data on the clouds (web server). The user selects the pellets size via the application on the smartphone. Servo motor on the containers will move to open the outlets and release the pellets. Feeding time can be set from the application. The weight sensor will measure the pellets weight in the containers every time after pellets releasing.

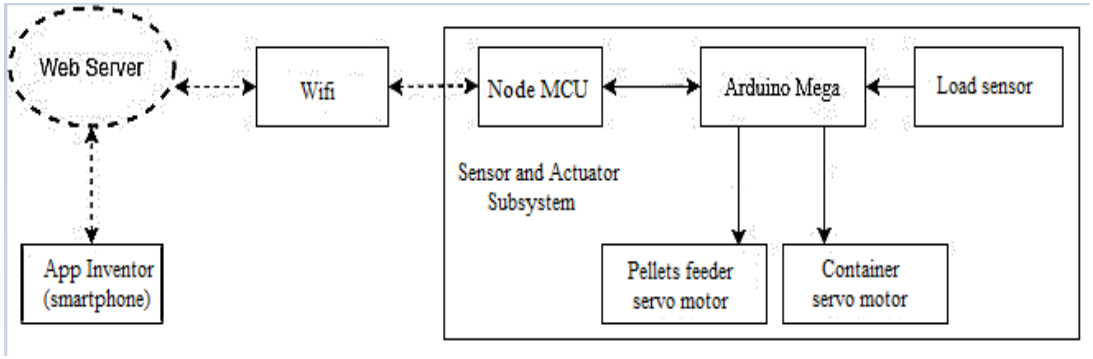


Figure 1. System Model

2.1. Activity Diagram

General flow diagram can be seen in Figure 2. The Figure 2.(a) shows the flowchart of the connection procedure and overall system work process. At the beginning of the process, the system will search for a Wi-Fi connection. If it is connected, then it will proceed to process monitoring and controlling procedure. The load cell sensor then will initialize the input port of microcontroller in figure 2.(b) and it will read the analogue data value of the sensor. Microcontroller which is connected to Wi-Fi, will send the data to App Inventor IoT platform webserver and display the data on the smartphone.

Figure 2(c) shows the controlling procedure of the automatic feeding system. First, user selects the pellets size from the App Inventor interface on the smartphone. If small size pellets (Size S) is chosen, then the interface will give 2 options, whether user can do the feeding process automatically or manually. If user selects automatic process, the system will give command to feeder and container outlets to open for 3 seconds every 12 hours.

Every time the feeder gives pellets to the pond for certain time period, it will also be given the same amount of pellets from the container. The procedure will have the same process for size M and size L, except that the opening time of feeder and container outlets become 5 seconds and 7 seconds. If user selects manual procedure, then every time user selects this option, system will do the feeding procedure without waiting for 12 hours.

Different procedure will be done if the user chooses “customize” option. User will not select the size of the pellets and the opening time of feeder and container outlets. However, user needs to determine how many fishes that has to be fed. According to this number of fish, system will automatically determine the opening time of the outlets.

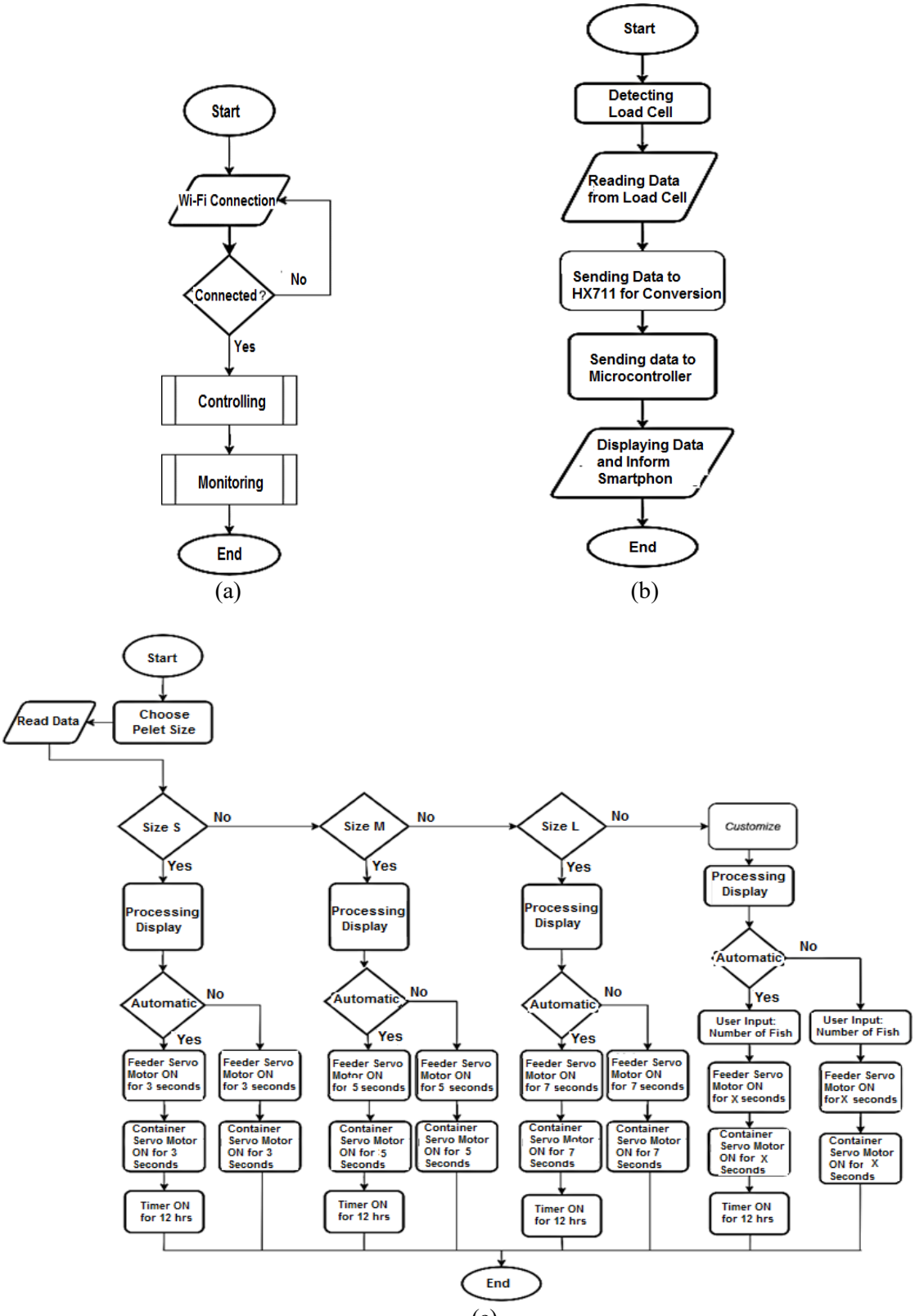


Figure 2. System Flowchart
(a). Connection procedure. (b). Monitoring procedure. (c) Controlling procedure.

Figure 3 shows the model construction of this two level feeding system. There are two containers. The lower container is pellets feeder and the outlets pipe directly leads the pellets to the fish pond. The upper container is the backup container which has bigger size and can be filled with larger amount of pellets. When the feeder takes out the pellets, the big container automatically supply more pellets to the feeder.

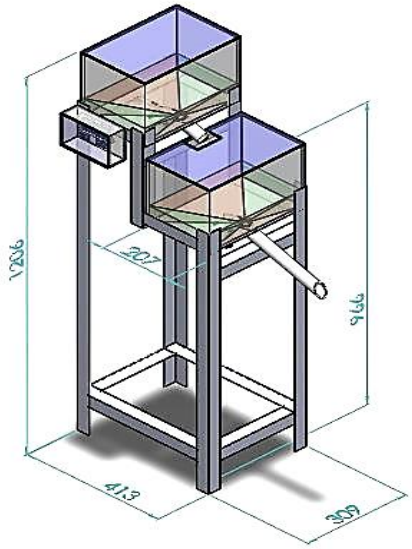


Figure 3. Design of the Hardware Model

3. Results and Discussion

The test results are shown in Table 1 and Table 2. Tests are done for S size, M size, L size, and customize size with manual and automatic settings. It can be seen that the two servo motors can open the containers outlets according to the setting in application on the smartphone. The number of pellets in Table 1 increase from around 50 grams, 70 grams, to 100 grams when the size of pellets increase from S, M, to L. It also increases according to the number of fish in customize option.

Table 1. Manual Setting

	Trial	Servo feeder	Servo container	Pellets weight (gram)	Note
S	1	Open	Open	46	-
	2	Open	Open	51	-
	3	Open	Open	50	
	4	Open	Open	47	-
M	1	Open	Open	77	-
	2	Open	Open	74	-
	3	Open	Open	72	
	4	Open	Open	75	-
L	1	Open	Open	101	-
	2	Open	Open	103	-
	3	Open	Open	101	
	4	Open	Open	102	-
Customize	1	Open	Open	30	1 fish
	2	Open	Open	89	6 fish
	3	Open	Open	147	10 fish
	4	Open	Open	228	15 fish

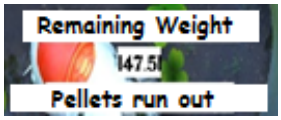
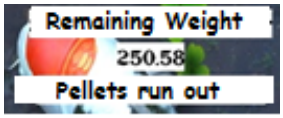
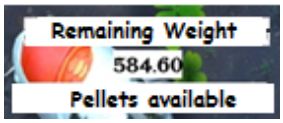
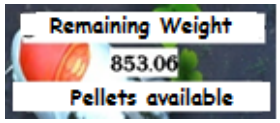
When automatic setting is selected as shown in Figure 3, the same condition is also apply. Time setting for automatic feeding is 12 hours. However, data in Figure 3 is collected once in a day, particularly in midnight time.

Table 2. Automatic Setting

	Trial	Time-1	Servo feeder	Servo container	Pellets weight time-1 (gram)	Time-2	Servo feeder	Servo container	Pellets weight time-2 (gram)	Note
S	1	23. 50	Open	Open	47	23.55	Open	Open	48	-
	2	24.34	Open	Open	46	24.38	Open	Open	54	-
	3	1.10	Open	Open	51	1.15	Open	Open	51	-
	4	1.45	Open	Open	54	1.50	Open	Open	50	-
M	1	24.05	Open	Open	75	24.1	Open	Open	74	-
	2	24.45	Open	Open	72	24.50	Open	Open	76	-
	3	1.20	Open	Open	76	1.25	Open	Open	73	-
	4	1.55	Open	Open	72	1.59	Open	Open	72	-
L	1	24.15	Open	Open	102	24.20	Open	Open	101	-
	2	24.55	Open	Open	103	24.59	Open	Open	102	-
	3	1.30	Open	Open	102	1.35	Open	Open	104	-
	4	2.50	Open	Open	101	2.10	Open	Open	101	-
Customize	1	2.25	Open	Open	29	2.30	Open	Open	30	1 fish
	2	2.33	Open	Open	88	2.38	Open	Open	87	6 fish
	3	2.45	Open	Open	146	2.50	Open	Open	147	10 fish
	4	3.05	Open	Open	227	3.10	Open	Open	229	15 fish

Load cell sensor testing can be seen in Table 3. Based on the test results, the load cell sensor can work properly. The App Inventor as an IoT platform also work well as it was designed. When the pellets weight is < 300 grams, a notification in smartphone will be "Pellets is running low", and if the pellets weight is > 300, notification is "Pellets is available".

Table 3. Load Cell Testing

Weight reading		Picture		Error (%)
Scale (gram)	Load Cell (gram)	Scale	Load Cell	
145	147			1.379
249	250			0.402
582	584			0.344
850	853			0.353
1534	1537			0.196

4. Conclussion

The system works well as it was designed. Systems can send and receive data to and from App Inventor, as IoT platform, correctly. The amount of pellets that are fed to the pond according to the pellet size or the number of fish selected. The weight of remaining pellets in the feeder and container can be read and display on the smartphone correctly.

Acknowledgments

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