International Journal of Integrated Engineering, Vol. 10 No. 8 (2018) p. 218-222

DOI: https://doi.org/10.30880/ijie.2018.10.08.031

Experimental Evaluation of Fish Feeder Machine Controller System

Ainul Husna Mohd Yusoff[1], Salihatun Md Salleh[1*], Mohd Ezree Abdullah[2], Izzuddin Zaman[1], Mohd Hatta Md Hani[3], Waluyo Adi Siswanto[4], Wan Azlan Wan Mahmud[1]

[1]Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.
[2]Faculty of Civil and Environment Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.
[3]Center for Diploma Studies, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.
[4]Mechanical Engineering Department, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia.

Received 1 March 2018; accepted 19 December 2018, available online 31 December 2018

Abstract: The aim of this project is to apply the automatic fish feeder controller system for fish pellet dispersion machine. The system uses Arduino as a microcontroller which programmed by setting the speed and timer of each DC motor to make this machine functioning automatically. When the adapter is switch, the microcontroller will be connected then activate the motor driver to generate the system. Two motors have been used as motor 1 and motor 2 which functions to drop and disperse the fish pellet respectively. The whole system was programmed through a specific coding and uploaded to the Arduino. This project benefits in reduce the manpower for the fish farming. The component that required to build this project is portable and cost-effective. From experimental result, the timer for motor 1 to dispense the fish food from the storage was 60s while 90s for DC motor 2 as a distributor. The speed for motor 1 was set to 110rpm while motor 2 was set with full speed of 255rpm. The fish pellet can be distributed and scattered up to 5m which can reduce the competition among the fish at one place.

Keywords: Microcontroller, control, automation, time execution, distributor part

1. Introduction

Nowadays, the fish farming is one of a business that have been growth rapidly. Fish farming has high potential to survive in business world as fishery sector becomes important sector that contribute to the economy enhancement. Also, fishery sector provides protein source which is vital for human consumption every day [1]. This sector act as a medium of employment and socio-economic opportunities for a community. Since the fish farming has high demand in the market, the production of the fish needs to be increased. As the market demand for fish is too high nowadays, it is difficult for the supplier to fulfill this demand [2]. The alternative way that can enhance the fish production is needed for the supplier to meet the market demand.

Hence, to increase the production of the fish and make sure there is a stock for the wholesaler, the feeding process is the most important aspect. Feeding is the important aspect that need to manage for the fish farming in aspect of growth and production and it is a challenge for aquaculture development. Usually the fish farmer spread the fish food manually according to the fixed schedule according to the type and size of the fish. But the fish farmer may have discounted to give the fish food by following the schedule. So, this system will use many manpower to make sure the fish food was given by following the schedule [3].

Also, the fish food that will be distributed is not uniformly distributed for each point of the pond. Then, the fish feeder machine was invented to overcome the problem. The fish farmer just needs to turn on the machine and this machine will spread out the fish food. But this machine still needs to be turned on manually by the fish farmer according to the schedule. This machine still uses a large amount of manpower to make sure the fish is fed.

The fish farming sector has a large contribution to the enhancement of the country's economy. This is because the demand for this sector is very high. Furthermore, fish is the main protein source for human consumption that make the demand is assumed to increase throughout the year. This statement is based on the previous research, it states that the consumption of fish in Malaysia is expected to increase by 2010 by 14% increment [4]. Then the manual feeding system has been improved by the automatic fish feeder system as a preparation to the high demand. Several microcontrollers have its features had been studied as in Table 1.

*Corresponding author: saliha@uthm.edu.my

Table 1 Microcontroller comparison.

Controller, Features and Cost	PIC	PLC	Arduino
			
	Need to be connected to a central processing unit (CPU) [5]	Need a central processing unit (CPU) which need a large space [6]	Only single board to get started which is space saving [7]
	C language, which not use object-oriented programming	Ladder logic programming which like electrical schematic	C++ language, which is object-oriented programming
	Cost-ineffective	Cost-ineffective	Cost-effective

A few fish feeder machine have been developed but the controller still need to be improved that can be installed and handle easily at the machine. This research is focus on the controller of the automatic fish feeder machine for dry pallets only. The improvement of the controller needs to make the machine to have uniform distribution of the pallets and accurate fish feeding timing.

2. Hardware and System Development

The suitable controller for the fish feeder machine is Arduino which control the system of the machine by receiving inputs and producing output. The type of Arduino used for the machine is Arduino Uno. This controller the machine according to the coding uploaded by the user. The process of many projects can be formulated in Arduino as it is an open-source single board microcontroller by manipulating electronics component [8].

All the functions of the machine can be uploaded in the Arduino. Besides, Arduino is the cheapest microcontroller compared to others [9]. It has been proven that integrated system can be developed as many electronics component can be interfaced by using Arduino [10-12]. The platform that can be used to create the coding of the whole process of the project is Integrated Development Environment (IDE) software. The coding that has been created in a software then will be uploaded into the Arduino.

The coding that has been created can be uploaded easily into the Arduino because of the advantage of the (IDE) software as an open-source. Furthermore, there is code editor provided in the software which make the user can verify and upload the coding to the microcontroller board easily [13]. A complex function of a complex system can be held with only a board of Arduino Uno. Also, it gives an additional advantage if using Arduino because it can activate through the application in the smartphone or computer by connecting through the Bluetooth or Wi-Fi. The whole process for the application that has been programmed can be generated through the Arduino software. The program for the applications can be adjusted by adjusting the coding through this software. This coding is written in high-level programming language which is in C or C++ form.

This automatic fish feeder using Arduino controller consists of a few electronic components that connected to the Arduino as a one complete circuit to carry out the function of the machine. A DC motor 1 was connected to the shaft of the paddle wheel through coupling as a mechanism to dispense the fish food from the storage. The paddle wheel is rotated to dispense the fish food onto the distributor plate in the PVC pipe at the bottom of the machine. This motor has a high torque of 15 kg/cm. It is very suitable for fish food dispenser as it has higher torque rather than speed.

Meanwhile a DC motor 2 is used to rotate the plate at the lower part of the machine. The plate will rotate to distribute the fish food to all the four PVC socket. This motor is supplied with 12V adapter and connected to Arduino with a connection to motor driver in the middle because the voltage supplied by the Arduino is not enough to operate the motor. The mechanism to distribute the fish pellet by the distributor plate required high speed to get a large force to distribute out the fish pellet from the plate. This DC motor is very suitable for distribute the fish food as it has higher speed than torque.

In this project, a L298N motor driver is used to drive the DC motor. Arduino can operate several kinds of motors and has low-power signals need to be driven into motor driver to control the high-power circuits of the DC motor to run it. The motor driver usually fabricated with several electronics components and it is easy to act as an interface with the component like motors. Some hardware components as shown in Fig. 1.

Motor 1: 12V DC Motor

Motor 2: 12V DC Metal Gear Motor

Motor Driver: L298N

Fig. 1 Hardware components.

2.1 Hardware and Software Integration

The amount of fish food dispensed from the container by the 12V DC motor is according to the coding that has been uploaded. Then, the DC motor at the bottom will distributed the fish food to the four PVC pipes as a chamber by rotating the distributor plate. The amount of fish food that going to distribute was controlled by the timing of the DC motor in the container. The timing of DC

motor to rotate the distributor plate also change according to the amount of fish food that need to be distributed. The flow for this system was the user just need to switch on the switch of the adapter to activate this machine. Then it will trigger the coding in the Arduino to carry out the function of the machine.

The input from the switch was known as a signal from it that will be received by the Arduino. The input that received by Arduino act as an output that switch on the electronic component in this machine. The fish pellet was dispensed out from the storage and distributed as the coding was triggered by the signal received by the Arduino. To choose the DC motor that will be going to use for certain mechanism, the torque required was important. The purpose of the torque calculation was to make sure the DC motor can carry out its function smoothly.

There was connection between two DC motor with the output pins of Arduino. 12V DC power supply was needed for the DC motor to function. Each DC motor was connected to Arduino through motor driver as it can prevent the Arduino from overload with the voltage from the power supply and it can control the speed of the DC motor. The schematic diagram and the connection between DC motors with Arduino are shown in Fig. 2 respectively.

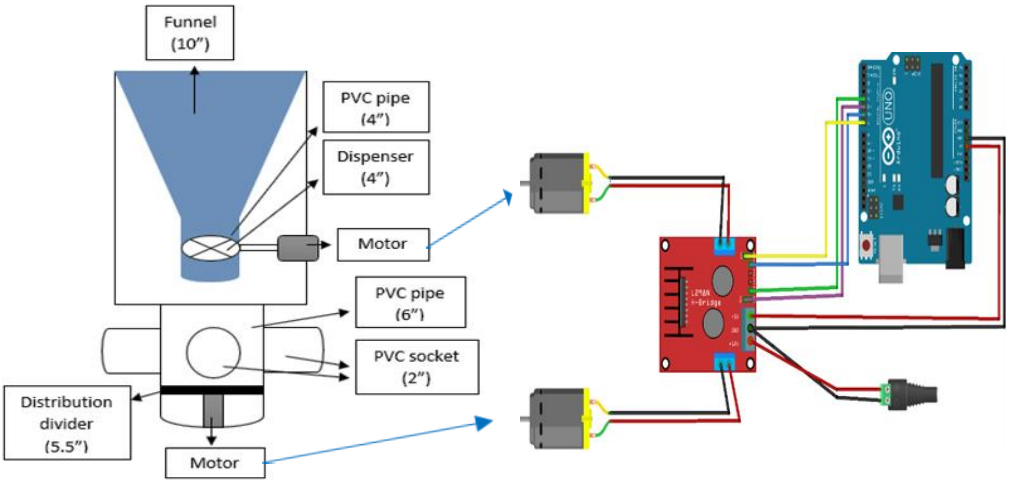

Fig. 2 The schematic diagram of the system and the connection between DC motors with Arduino.

2.2 Experimental of time execution of DC motor procedure

The purpose of this testing was to identify the suitable time to be implemented for each DC motor through the coding of Arduino to distribute certain weight of fish pellet. A few time intervals were set up and the fish pellet that has been distributed was weighed. The storage was filled up with 5kg fish pellet. The timer was set up for DC motor 1 with 15s while 23s for DC motor 2. The coding was uploaded to the Arduino and adapter was switched on. The fish pellet that has been distributed was weighed. All steps were repeated with different time for DC motor 1 and 2 at 30s, 45s and 60s for DC motor 1 while 45s, 68s and 90s for DC motor 2.

2.3 Experimental of speed of DC motor 1 procedure

This testing was conducted to identify the time taken of fish pellet dispensed from the storage according to certain speed of the DC motor with a constant weight of fish pellet. This data was important because the speed of DC motor 1 need to be synchronized with DC motor 2 to make sure the fish pellet can be distributed smoothly by the distributor plate. Testing steps had been conducted as follows. The storage was fill up with 600g of fish pellet. The speed was set up for dc motor 1 with 110. The coding was uploaded to the Arduino and the adapter was switched on. The time taken for fish pellet to dispense was recorded. All steps and were repeated with different speed of DC motor 1 which were 130, 150, 170, 190, 210, 230 and 250.

2.4 Experimental distance of distributed fish pellet procedure

The testing was conducted with different speed of DC motor 2 with constant time operation and amount of fish pellet. The purpose was for the suitable speed for DC motor 2 to operate. Testing steps that has been conducted as follows. The storage was fill up with some amount of fish pellet. The speed was set up for dc motor 1 with full speed which was 255rpm while dc motor 2 with speed of 100. The coding was uploaded to the Arduino and the adapter was switched on. The distance of the fish pellet that has been distributed has been measured with three different distance consist of the short, middle and long distance. All steps were repeated with constant speed of motor 1 while different speed of motor 2 which were 150rpm, 200rpm and 250rpm.

3. Results and Discussion

The time operation for DC motor 1 and 2 were determined from the testing that has been conducted. Four trial of time reading was implemented for motor 1 and 2 with both motors gives increasing weight of drop and disperse of fish pellet, respectively. The maximum dispersion of fish fillet occurs when motor 1 operated at 60s and motor 2 operated at 90s which gives more than 500g of fish pellet weight as shown in Fig. 3. These operated times for both motors will become a reference to have normal schedule of 500g fish feeding.

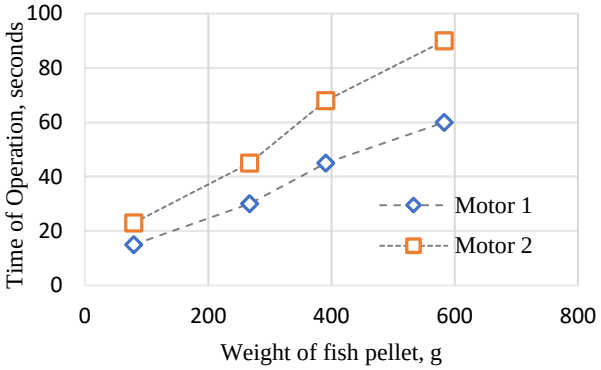

Fig. 3 Time of operation for motor 1 and motor 2.

The effectiveness of blade dispenser with motor 1 need to be tested as it need to be synchronized with motor 2. A testing was conducted with 600g of fish pellet with different speed of DC motor 1. The time taken for the fish pellet to dispense was recorded in Fig. 4. As the speed of motor 1 increases, the time taken to drop fish pellets will become faster. From previous data, motor 1 required about 60s to be operated with motor 2, thus speed of motor 1 about 110 rpm is suitable to be chose for machine setting.

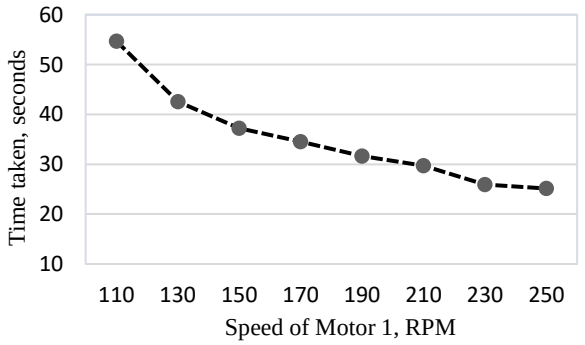

Fig. 4 Time taken to drop fish pellets at different speed of motor 1.

The mechanism of blade dispenser that re-use from cereal dispenser part has been reproduced to be operated by motor 1. The blade moved smoothly as the condition of drop palette requires delay time of 54.7s at speed 110 of motor 1 so that motor 2 is ready to disperse fish pellets.

Another experiment that has been conducted beside the time execution of DC motor and speed of DC motor 1, was an experiment about the distance of distributed fish pellets. This testing was conducted by setting different speed of DC motor 2 and the distance of dispersion of fish pellet was measured in three different distance. This was important to decide the speed of motor 2 as a distributor mechanism. The dispersion was measured at shortest, medium and longest distance as represented in Fig. 5.

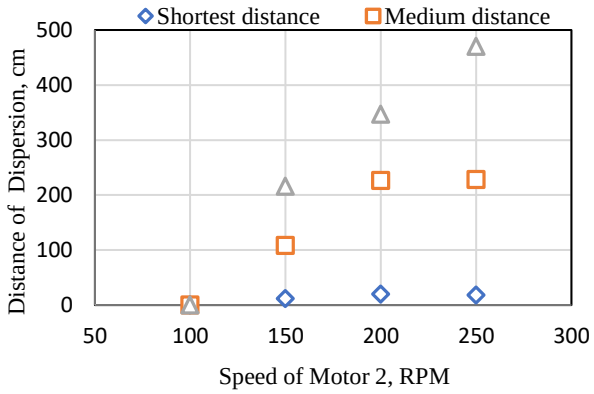

Fig. 5 Fish pellets dispersion at different speed of motor 2.

The distance of fish pellet dispersion in Fig. 5 shows that increase the motor 2 speed will longer the distance of dispersion at any measurement distance. From observation, the speed of DC motor 2 was fix with full speed of 255 rpm as it can disperse the fish pellet for the longest distance. The longest distance, 500 cm of dispersion improve the mechanism of machine from the previous research that reached less than 400 cm.

4. Summary

In conclusion, the automation part of the fish feeder machine has been improved by using Arduino as a controller. All the electronics component functioning according to the coding in the Arduino. This fish feeder machine was used the technology of Arduino which was the new technology where the usage was not widespread yet for the existing machine. The distribution system of the automatic fish feeder machine has been improved as it can disperse the fish pellet for four different channel of PVC pipe. Also, the fish pellet can be distributed for different distance where the fish pellet was scattered so that it can reduce the competition among the fish at one place. In future, the solar panel and sensor as indicator of empty storage is an optional to be installed.

References

[1] Abdallah, S. E., and Elmessery, W. M. An Automatic Feeder with Two Different Control Systems for Intensive Mirror Carp Production. *Journal of Agricultural Science*, Volume 4, (2014), pp. 356-369.

[2] Wahid, H., Noor A. F. M., Burhanuddin D. H., Ghazali, R. Design of an Automated Hybrid System for Aquaculture and Agriculture Process and Its Performance Analysis. *International Journal of Integrated Engineering*, Volume 9, (2017), pp. 49-56.

[3] Mohapatra, B. C., Sarkar, B., Sharma, K. K., & Majhi, D. (n.d.). Development and Testing of Demand Feeder for Carp Feeding in Outdoor Culture Systems.

Agricultural Engineering International: the CIGR e-journal, Volume 11, (2009), pp. 1-10.
[4] Emmanuel, O., Chinenye, A., Forolunsho, G., Richardson, O., and Peter, K.J. Development of an Automatic Fish Feeder. *African Journal of Root and Tuber Crops*, Volume 10, (2013), pp. 27-32.
[5] Arvind, S.K., Arun, T.A., Madhukar, T.S., Deka, J. Speed Control of DC Motor using. PIC 16F877A Microcontroller. *Multidisciplinary Journal of Research in Engineering and Technology*, Volume 1, (2014), pp. 223-234.
[6] Chitra, S., and Raghavan, V. Conveyor Control Using Programmable Logic Controller. *International Journal of Advancements in Research & Technology*, Volume 4, (2014), pp. 25-31.
[7] Devika, S. V., Khamuruddeen, S., Khamurunnisa, S., Thota, J., Shaik, K. Arduino Based Automatic Plant Watering System. *International Journal of Advanced Research in Computer Science and Software Engineering*, Volume 4, (2014), pp. 449-456.
[8] Sethuramalingam, T. K., and Karthighairasan, M. Automatic Gas Valve Control System using Arduino Hardware. *Bonfring International Journal of Power Systems and Integrated Circuits*, Volume 2, (2012), pp. 18-21.
[9] Purkayastha, A., Prasad, A. D, Bora, A., Gupta, A., Singh, P. Hand Gestures Controlled Robotic Arm. *Journal of International Academic Research for Multidisciplinary*, Volume 2, (2014), pp. 234-240.
[10] Almali, N., Bahir, K. S., Atan, O. Arduino Based Smart Home Automation System. International Journal of Scientific in Information Systems and Engineering, Volume 2, (2016), pp. 1-5.
[11] Ambar, R., Ahmad M. S., Jamil, M. M. A. Design and Development of a Multi-sensor Monitoring Device for Arm Rehabilitation. *International Journal of Integrated Engineering*, Volume 3, (2011), pp. 55-62.
[12] Dahari, N. Z., Wahid, H., Ling, L. P., Rahim, R. A. Design of a measurement device for air-pollution concentrations using an open-source electronics software and hardware system. *International Journal of Integrated Engineering*, Volume 9, (2017), pp. 61-70.
[13] Sudhan, R. H., Kumar, M. G., Prakash, A. U., Devi, S. A. R., Sathiya, P. Arduino ATMega-328 Microcontroller. *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering*, Volume 3, (2015), pp. 27-29.