The design of Litopenaeus Vannamei automatic feeder

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Abstract. The province of Bangka Belitung in Indonesia has a potential of ocean fishery production of about 1,200,000 tons per year. On the other side, there is another opportunity for the government to take advantage of the mainland usage for ocean fishery. Vannamei shrimp is one of the fishery product that can be farmed on mainland. Nowadays there are numbers of Vannamei shrimp’s company in Bangka Belitung. Feeding process of Vannamei shrimp is one problem in this business. The food residual can cause about 60% of organic waste. To anticipate this problem, an automatic feeder has been developed, even though they are not optimized yet. The propose of this study was to design a new method of automatic feeder which can spread the pellets from 0 to required distance in meters and of a food transporter that can flow pellets properly. The machine has been designed to be operated using android-based system. This brings the ease of use to control and monitor the feeding process. The result shows that the automatic feeder can achieve 15 meter in maximum distance of food throwing. Spreading the food can be from 0 up to 15 meter based on the speed controlling of throwing (0 to 700 rpm). The auto-feeder can also be monitored using android system such as the volume of the food, and on/off the system manually.

1. Introduction
The province of Bangka Belitung in Indonesia has an opportunity to take advantage of mainland usage for ocean fishery. Litopenaeus Vannamei is one of fishery product that can be farmed on mainland. Nowadays there are numbers of Vannamei shrimp industries in Bangka Belitung. Based on the statistical information published by BPS in 2017, Bangka Belitung province has only used 419.14 hectare of land for fishery from the total of 1,602 hectare. The Vannamei shrimp has been farmed on small portion of that land, while Vannamei shrimp sits on the highest export commodity of the ocean fish product that is about 40% compared with others. Nowadays there are numbers of Vannamei shrimp’s company in Bangka Belitung. Feeding process is one problem in this industry. The foods and its vitamins consume about 50-80% of the total cost. It produces food residual that can cause about 60% of organic waste. Some solutions has bee studied to anticipate this problem by examining the feeding process. It has been conducted since more than three decades ago [1-6]. The intelligence control of feeding system by considering the water quality as the impact of organic have been studied in [7, 8]. Even the use of computer system in the experiment have been implemented in [9, 10]. On the other side, one of Vannamei farmer has used the automatic feeding system produced by eFishery (www.efishery.com). This auto-feeder has several problems such as: (1) the food spreading does not cover all area, (2) the mechanical system or food transporter could not be used for long time (it needs to be replaced frequently).
This paper presents design of automatic feeder for Litopenaeus Vannamei which can be controlled using smartphone and able to throw pellets from zero to the adjustable maximum distance.

2. Experimental Setup

The experiment was conducted in the real Litopenaeus Vannamei pond to test the proposed system, while the designing of mechanics and electronics system was organized in the laboratory. This research was carried out by (1) designing the whole system incudes the mechanical, electronics and control system, (2) testing and evaluating the system.

2.1. System Design

The system of automatic feeder in this research was designed by conducting the literature review of current existing system, and discussing the required system with the owner and supervisor of the Litopenaeus Vannamei fond. There are many models and concepts of automatic feeder for fish and vannamei shrimp [9, 11]. While our partner in this research use eFishery’s product (see https://www.efishery.com) for their Vannamei farm.

According to the owner and supervisor of the Vannamei farm, the automatic feeder system is supposed to be able to: (1) throw the pellets from 0 to the maximum distance (15 meters), (2) feed the Vannamei shrimp for the age above 30 days, and (3) accommodate the pellet up to 50 kg.

From the requirements above, the design was then divided into mechanical and electronics control system.

2.1.1. The mechanical design. The design involved three parts of the mechanical system which are the pellets container, thrower system, and mechanical supporting system. The pellet container was designed with two parts. The first part is the container itself which is attached to the second part (a funnel). The whole system is shown in Figure 1.

![Figure 1. Container and throwing system](image)

Pellet container is made of aluminium plate with 0.6 mm thick, 50 cm in diameter, and 40 cm in height. This container can be used for 50 kg pellet in it. The second part is the funnel which attached to bottom part of the container. This funnel is used to connect the container to the transporter before pellets...
are throwing. The throwing system is separated into parts. The first part is called as a transporter. Its function is to transfer the pellets from the funnel to the thrower. This transporter is driven by a 12 volt dc. If it is facing up, pellets will go down to the transporter cylinder, and when it is facing down the pellet will go down to the thrower. This transporter is connected to thrower which is the final element to spread pellets around the pond. By rotating this thrower, pellets are spreading out gradually from 0 up to 15 meters distance. This thrower is driven by a 24 dc motors. The throwing distance is adjusted by controlling the dc motors speed.

To put this automatic feeder in the Vannamei pond, it needs a supporting system. All mechanical system shown in Figure 1 are attached to the supporting system. It is adjustable from 0 up to 273 cm in height as shown in Figure 2. In the experiment, the height of throwing system was adjusted up to 160 cm to get maximum required distance.

![Figure 2. Container, throwing system, and its support](image)

2.1.2. The electronics and control part. In general the electronics part of this auto feeder is shown in Figure 3. This control system is Android based control system. The automatic feeder can be controlled manually using the available keypad on the control panel, or using an Android based smartphone. There are two dc motors to throw pellets around the pond. The first is a 12 volt dc motor as the transporter which transport pellets from the container to the thrower by rotating the transporter tube. The second is a 24 dc motors which is throwing the pellets from 0 up to 1400 rpm. With this variable speed, the distance of pellets throwing can cover all the required area of the pond.
2.2. Testing and Evaluating the System
This stage was conducted to ensure that each mechanical part is working properly. Majority of the test were conducted in campus. It consisted of testing on throwing system and testing the ability of system to measure the existing volume of pellets.

2.2.1. Throwing System. The first was testing the throwing system by giving the suitable power to 12 and 24 volt dc motors. Once it work, the test was continued to test on/off those two dc motors with controller. The controller should be able read the input parameters entered by user and then update the condition of dc motors based on the algorithm entered. After examining the dc motors for throwing system, the second stage was to test the distance of pellets throwing. By giving the angle of thrower fixed at 45°, the measurement of throwing distance with maximum rpm (7000) and maximum voltage at 24 volt are shown in Table 1.

| Height | Distance (m) |
|--------|--------------|
| 10     | 7.5          |
| 40     | 9            |
| 70     | 10.5         |
| 100    | 12           |
| 130    | 13.5         |
| 160    | 15           |

Table 1 shows that with maximum height of thrower from the water level, it gives the maximum distance of throwing at 15 m. By gradually adjusting rpm from 0 up to 7000, the distance of throwing will be gradually spread pellets from 0 up to 15 m.

2.2.2. Pellets Volume monitoring. This monitoring system is to inform the availability of pellets in the container. It uses ultrasonic sensor to detect the distance between the top level position of pellets and
the sensor itself. This is then converted into the percentage of pellets volume. For example, Figure 4 shows that there are 50% pellets in the container. This information is shown on smartphone.

**Figure 4.** Pellets volume indicator on a smartphone

The test was conducted by comparing the real volume of pellets in the container and the percentage of pellets shown on smartphone.

### 2.3. Testing the Whole System

At this stage, the whole system was examined at the real Vannamei pond. The test was started to carry out the time consumption to spread the pellets (1 kg for 1 time of feeding process) around the pond.

| Transporter Rotation          | Time Consumption (minute) |
|-------------------------------|---------------------------|
| Along with thrower            | 1                         |
| After thrower                 | 2                         |
| After thrower spinning 2 cycles | 3                       |
| After thrower spinning 3 cycles | 5                       |

The testing was divided into four combination of transporter and thrower rotation. “Along with thrower” means that the transporter was rotating as the same as the thrower. “After thrower” means that the transporter was rotating after the thrower rotating 1 cycle. “After thrower spinning 2 cycles” and “After thrower spinning 3 cycles” were defined that transporter will make one rotation after the thrower spinning 2 and 3 cycles consecutively.

For the whole 50 kg pellets, the feeding process can be adjusted based on the data shown in Table 2. Operator can enter the time to feed and how much pellets (in kg) should be thrown for one time feeding.

### 3. Conclusion and Future Work

The experiment described in this paper show that the requirements of an automatic feeder for Lipoteneaus Vannamei were fulfilled. The proposed system were able to spread pellets around the Vannamei pond. The maximum required distance was able to be reached. It was also able to be operated using an Android based smartphone.

This research was conducted to build the automatic machine which was examined to work as required. The work needs to be continued to compare the use of this proposed machine with the existing method in terms of organic waste produced by feeding process.

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