

DEVELOPMENT AND PROTOTYPING AN AUTOMATIC FISH FEEDER

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I hereby declare that the work in this report is my own research except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

An automatic device to feed fish at predetermined amounts of food and time. Fish feeder combines mechanical and electrical system to control fish feeding activity. This device consists of pellet tank, distributor and a stand. The dispensed food will be controlled by a motor which situated under the tank. A propeller design that differs by angle of force applied to spread the food, will distribute the pellet onto wider water surface which is controlled by the outlet gap. A control system attached to this device allows the fish to be fed at predetermined food amount and time. Timer is used to control the motor which run the gear and propeller to increase functional efficiency. The fish feeder is successfully fabricated and tested. Feeding can be done at predetermined interval of time and accurate amount of food with larger surface area covered by pellet is obtained. Furthermore the waste of fish food in pond is reduced efficiently.

ABSTRAK

Sebuah alat otomatis untuk memberi makan ikan pada jumlah dan masa yang tertentu. Pemberi makan ikan menggabungkan sistem mekanikal dan elektrik untuk aktiviti memberi makan ikan. Alat ini terdiri daripada tangki makanan, penabur dan pemegang. Makanan yang ditabur akan dikawal oleh motor yang terletak di bawah tangki. Rekaan kipas yang dibezakan oleh sudut daya dikenakan untuk menabur makanan, akan membahagikan makanan ke permukaan air yang dikawal oleh bukaan keluar. Satu sistem kawalan yang diletakkan pada alat ini membolehkan ikan diberi makan pada jumlah makanan dan masa yang tertentu. Penentu masa digunakan untuk mengawal motor yang menggerakkan gear dan kipas bagi meningkatkan kecekapan berfungsi. Pemberi makan ikan ini berjaya dihasilkan dan diuji. Pemberian makanan ikan boleh dilakukan pada selang masa tertentu dan jumlah yang tepat dengan luas permukaan yang lebih besar ditutupi makanan dapat diperolehi. Selanjutnya pembaziran makanan ikan di dalam kolam dapat dikurangkan secara berkesan.

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LIST OF SYMBOLS AND ABBREVIATIONS

τ	-	Torque
F	-	Force
Fr	-	Fiction force
Fa	-	Applied forced
R	-	Radius

N	-	Newton
kg	-	Kilogram
π	-	Phi
t	-	Time
RPM	-	Revolution per minute
AC	-	Alternating current
DC	-	Direct current

CHAPTER 1

INTRODUCTION

1.1 Project motivation

Food and feeding are the keywords of growth and production, their management being one of the main challenges for aquaculture development. The adjustment of food delivery to match fish appetite plays a key role to maximize the income or benefit for aqua industrialist. Related to economic aspect, especially for highly invested aquaculture project, the control of fish feeding will determine the survivor of the company involved [1]. The correct practice or management of fish feeding also link to small aqua project which cannot be ignored as this matter contribute on how they can return good profit from this aqua activities. Conditions which prevail in intensive aquaculture make this problem complicated. These difficulties can impede the adjustment of food delivery to match variation in fish demand, leading to environmental pollution when overfeeding fish and growth loss when underfeeding fish. The effects are same whether the purpose is for industry or even small aqua activities such as aquarium and pond livestock.

The relative feed efficiency of fish farming is a complex subject that has not yet been fully analyzed with current technology, so the only source that can be use to level the effectiveness of a feeder is from analytical data which differs from certain research and thus, is suitable for the same parameter only [2]. The data sometime does not fit for universal use that consists of additional or different parameter such as type of fish, size, place, surrounding and others. It is the purpose of the present invention to provide an automatic feeding device which meets the above feeding requirements thus largely

eliminating the need in expensive, experienced labor, thereby reducing the cost of raising fish. The cost of feed is usually the greatest operating cost in aquaculture, which may account 40% or more of total operating cost in an eel culturing system [3]. It has been estimated that over 60% of the feed placed into aquaculture system ends up as particulars [4].

In order to solve this problem, several direct and indirect techniques have been developed. Self feeders may be used for direct adjustment, whereas indirect methods have also been used based on hydro acoustic technology for control of feed waste. Therefore, the aim of the present study is the development of a feeder that can handle good control of fish food feedings.

1.2 Project background

Several systems of ponds, tanks or cages are used in farming fish. With the advanced technology, today's ingredients were transformed into pellet form through a local feed mill company. Most marine finfish are reared in floating net cages near shore, and all their nutrition is supplied by formulated feeds. Carp and other freshwater finfish are usually grown in ponds, often integrated within agricultural ecosystems. There are several major and minor problems that are being study recently in order to improve feeding system and management. One of these major problems is to reduce cost of feeding and increase the efficiency of this task at the same time. This is because the future investment will include labor cost that spent by entrepreneur such as taking workers to work at their pond. This will even require higher spending just to settle out for the workers especially for bigger industries which involve high value and long term investment. They need to hire more people to look after their fish in order to make sure that their earlier investment will not only become a waste, but benefit them later on.

Nowadays some of aqua industrialist has improve their feeding management by using high-tech gadgets or machine for their fish, but instead of this, still, they sometime need manual survey, which is referring to human job to manage their machine.

There are many jobs that require man power to execute the task such as cleaning the feeder, refilling the pellets, and even repair or maintenance procedure. Thus clearly, the problem here is to invent a low cost and easy maintenance machine that can help them to feed their fish. The feeding device should be simple in construction and operation, reliable in operation, and relatively inexpensive to purchase and operate. This solution also must have good efficiency in the way it operates and serves as a dependable worker.

Some methods were developed to detect left over feed in order to stop the feeding. Shepherd and Bromage estimated food waste by suspending a sheet below the sheet cage during the feeding period, retrieving it after feeding, and counting the left over feed pellets [5]. Besides, Juell used hydro acoustic sensors to detect food pellets at 2.5 depths in sea cages for feeding control [6]. Foster et al used an underwater camera and image analysis tool to detect and count left over pellets by the fish in underwater sea cages [7]. Other method to stop feeding before the water was polluted such as Fang and Chang that used the reflective type photoelectric sensor to detect the gathering behavior of eels, which is incorporated in the feedback concept. The results showed that stopping a feeding cycle before polluting the water is possible using floating feed for eels. Based on previous study, an intelligent feeding controller based on gathering behavior has been evaluated in a pilot scale commercial fish farm [8].

One parameter that involve in a feeder is time management controller that act as main part of a feeder. Many industrialists in aqua field seem to have trouble with this timely operation. Traditional method of feeding fish either for fish in pond, cage or even small lake is by use of man power. For the worker, they sometime face difficulties to do the feedings at the same exact time during some unexpected event especially when raining. If they continue the job, the only result are not just the pellet ending at the bottom of the pond as waste faster, or lead water to pollute, but the main critical problem is the unfed fish. This matter will even grow bigger during raining season and will cost a lot of trouble to the industrialist. This is a very clear example to show how important is timing variation, that determine when is the meal time for the fish. The meal time usually can be change depends on the user coincide with some specific condition

such as type of fish, size of the pond, quantity of fish, and many other aspect which selected by the programmer or user to set the time. Moreover, the running period for each feeding also determine by this timer that is also programmed by the user. The feeding device includes means on the control means to vary the length of each predetermined interval.

Other major problem that is still on its way to be solved by current invention is the perfect distribution of pellets or fish food from the feeder to water surface. Most of the today's machine only focus on how to timing the feeding session and just drop out the food with no proper or effective way before they are eaten by the fish. Many consequences can occur from this issue such as water pollution as the food dispersed at the bottom at the water source. After a period of time , the worker then will need to do extra job that is to clean the pond and changing the water will become a frequent task for them if this matter still on the problem list. The feeder which drop out the fish food use door mechanism to manage the opening and closing the gate where the food move before spread onto the water surface. By this way of distributing, there are high possibilities that the food only a small area of water surface will be where bombarded with the food and doesn't reach a region at least where the fish can easily found their food. This is a serious matter which the growth of fish may not uniform in term of their size because of ineffective feeding.

There are many cases where we can see the pellets were jammed at the outlet of the machine or along the tunnel of the device. This problem occurs mainly because of two reasons. Firstly the properties of the pellet itself that cannot be exposed to moisture as it absorb the water molecule quite fast as today's pellet are made into dry food type. Secondly, the size and shape of pellet usually a short cylinder which separated from a long cylinder shape. As a result, we cannot assume the flow of this type of food as a smooth flow such as the smooth fluid flow properties. Thus, this restriction may cause them to stuck along the outlet tunnel or at the end of the outlet with additional of the moisture effect to the fish food.

1.3 Project problem statement

There are several problems that were considered in inventing this feeder device in order to improve efficiency of previous designed fish feeder.

1.3.1 Less effective of manual feeding

Most of today's invention of fish feeder concentrate on inventing a timely, accuracy feeding device which can replace or reduce the use of labor in aqua industries which also being adapted into the management in aquarium use. This is one of the main function that is very important in designing efficient feeding system for this project. The system must be able to be controlled or adjusted by user according to their demand and needs. As referring to 'automatic' word itself, the feeder should be able to be operated without supervision of human at least at certain interval of time. Manual feeding by using man power requires skilled workers to avoid the waste of pellet that are supplied to the fish.

1.3.2 Limited pellet distribution area

The next issue here is to make sure that the use of pellet towards right amount or enough food from the pellet container to the fish. Common feeder delivers pellet by flow out the pellet from the tank to the area near the tank itself and technically not distributing them onto the surface of the water in term of fair spreading. This kind of delivery usually use simple motor and door concept to limit or control the opening of the gate where pellet or other fish food were led through the outlet. Although this type provide accurate feeding time and amount of food, the area that are to be fed are only in small range. In more detail, the feeding device covers a very small area in the pond only. Besides, in some cases, the feeding device need to be placed at center of the pond in order to achieve maximum efficiency of pellet feeder by assuming that fish are more likely moving or mostly be at the center of the pond. This solution may suitable for aquarium use which constrained the movement of the fish. Unfortunately, the impact of

using the same feeder to a pond or lake are not giving the same result in term of feeding efficiency which is refer to the conservation of pellet from the tank and after they were spread out onto the water surface. So from this observation, a new distributor needs to be design to improve feeding method for fish in pond.

1.3.3 High cost of feeder

Some advanced model of feeder use blower support to spread those fish food by using air from surrounding, compress them, and then blow the pellet where random distribution is applied to the water surface. At this rate, the pellet are not being bombarded to a fixed place only but their distribution is randomly onto the pond, which is more effective when it is compared to the older design. However, when it comes to a total cost of this design, it is a bit expensive as this invention requires higher cost of parts. This high cost matter has become a burden to a beginner industrialist in aqua industries as this will make them increase the estimation of their spending for the business. So the cost of feeder invention also need to be reduce or at least match the customer demand as today's market offer varieties of this kind of device to the customer [9].

1.4 Project objectives

The objectives of this project are explained based on project problem statement and project scope.

1.4.1 Design and simulation of a new fish feeder

This project is to study the review of previous feeder designs and the specification of the device to develop a new automatic feeder that consist mechanical and electrical component which can be operated with simple mechanism to achieve its purpose, feeding the fish. All of the appropriate component will be assembled to formed feeding

device that simple in construction and operation, reliable in operation, and relatively inexpensive. This feeder also will be simulated to calculate the efficiency.

1.4.2 Elimination of waste of pellets dissolved in the water

The new design is proposed to solve the matter from previous design, which will lead to a better and the proper distribution of the fish food. This will eliminate waste of pellets dissolved in the water, reduce the effect of water pollution, and avoid the unfed fish problem due to improper or poor food distribution. This design also will require less cost that spent for its manufacturing. It also will contribute to an accurate timing and amount of fish feeding and improve the previous machine use in term of efficiency, which refer to the better distribution of the fish food or pellet.

This new design can be use as a benchmark for further improvement of feeder relative to other interested parameter.

1.4.3 Fabrication and testing of a new feeder

The design of this project will be fabricated and assembled with several steps and parts that can be started by simple sketching followed by the use software.

- 1) Body/ housing
 - Design appropriate size of pellet tank using software.
- 2) Mechanical part.
 - Design the blade for distributor using software.
- 3) Electrical parts
 - Select suitable electrical component.
 - Construct the circuit planning.
- 4) Matching.
 - Mechanical and electrical parts matched in solid work software.
 - Adjustment and additional part to make proper design.

5) Build mechanical parts

- Involve machining and finishing of work piece.

6) Assembly

-Mechanical and electrical parts assembled and will be tested.

1.5 Project scope

Since this project is concentrating on system of an automatic feeder and the distribution aspect, there are some limitation still of this project that need further attention and research by researcher to analyze and enhanced capability and improvement.

1.5.1 Moisture effect

Fish food in the tank which located at the top of the feeder are exposed to moisture existence in air which can affect its condition. Moreover, pellet are made of several ingredient such as varying ratios of corn, high-oil corn, soybean meal, and mechanically expelled soybean that are composited into pellet and this type of food can easily melted when it is react with water. This problem may occur during raining season or at the place that experience high contain of moisture in air especially at high place, geologically. When there are differences in temperature between inside of pellet tank and the atmosphere outside of the product, condensation can occur under this condition. When this is happening, an amount of water or moisture will be formed at the surface of the tank and this formed water can affect the pellet that can easily absorb them due to the micro structure and properties of the pellet itself. The melted pellet may cause the pellet flow in the tunnel of fish food to clogged up and no pellet will be distributed to the water surface.

1.5.2 This project is a prototype only

This project is only for research purpose and not for commercial. That is because this product only considers certain parameter to be studied seriously to find a better solution compared to previous invention. Besides that, this product reliability for other different parameter which depends on user is not included in this thesis is. Some example which limits the use of this prototype is such as weather constraint. Since almost all of this prototype will be made of steel and sheet metal, so its durability at a place where experience raining frequently is out of determination. Besides that, the strength of this prototype is not for extreme use such as during storm because this project never tested under that condition. If this kind of constraint were to be ignored, they may lead to other consequences which can results the failure or defective of this product.

1.5.3 Not suitable for aquarium use

Regards to this feeder main function and its size, this invention is only suitable for outdoor use such as pond, lake and sometime suitable for floating fish cage in river with some different additional design and structure. Since this device produce long range in term of pellet spreading, its use in aquarium is not applicable because of limited space and cost matter. The common home size aquarium is about 1 meter may require less power motor or the smaller size feeder. Besides, aquarium feeder may not need spreader or pellet distributor in its mechanism because of the small size of the water surface area.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide the review of previous invention of fish feeder in many journals from various references. Besides, this chapter also reviews some components that will be used in this project with some other related studies. The contain of this chapter focus on the aquaculture field, types of pond and fish, fish food type and their composition, and the previous design of fish feeder itself.

2.2 Aquaculture

Aquaculture is the farming of freshwater and marine plants and animals. Evidently, all aquaculture is done in water and, because it is a farming activity, involves the considerations of property or the farmer who owns the products and activity or work is done in order to raise the animals or plants. Sometimes, the terms "aquiculture" and "aqua farming" are also used. This activity was done in many water source types such as river, pond, lake and others. Today's industrialist take part in this activity by investing a large amount of money in managing, inventing and also marketing the output of aquaculture which promise a good potential as a profit source to gain back a good income to them or their company [11].