UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Automatic Fish Feeder for Cultivation Pond

Thesis submitted in accordance with the requirement of the Technical University of Malaysia Malacca for the Degree of Bachelor of Engineering (Honors) Manufacturing (Robotic & Automation)

By

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BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **Automatic Fish Feeder for Cultivation Pond**

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…….

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I hereby, declare this thesis entitled “Automatic Fish Feeder for Cultivation Pond” is the results of my own research except as cited in the reference.

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DEDICATION

To God for His blessings,
To my beloved parents for their support,
To my family for standing besides me,
To all my friends for their encouragement and help,
To my supervisor for her guidance,
And to everyone who had helped.

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The first person I would like to thank is my parents. Their constant support throughout my whole life helps bring me here to the place I am today. Their moral and financial support helps me to complete this project.

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ABSTRACT

The title of this project is “Automatic Fish Feeder for Cultivation Pond”. The objective of this project is to design and manufacture a prototype automatic fish feeder which will be used in cultivation pond. Besides that, another objective of this project is to use the programmable logic controller (PLC) as a controller to control the machine. The components for the developed machine can be divided into two types which are automation blocks and mechanical parts. Automation blocks components includes a power window motor, limit switch, relays and a PLC controller. The mechanical parts include valves and also the mechanical structure of the machine. Results show that the machine would be able to feed the fish at a certain time range which is being set by the user using the built-in timer in the PLC controller. Besides that, the feed would be distributed across the pond for a certain distance by using a blower (fan) which will be rotating at a certain angle thru and fro. Since this is a prototype machine, an actual machine can be produced for the future. Besides that, one of the main future developments is to network the whole system which means by combining a few PLCs and controlling them from only one control center. As a conclusion, this project is quite successful because it is able to fulfill all of the objectives stated and also performing up to expectation.

ABSTRAK

Tajuk projek ini adalah “Automatic Fish Feeder for Cultivation Pond”. Objektif utama projek ini adalah untuk merekabentuk dan juga membuat sebuah mesin prototype automatic fish feeder. Selain itu, objektif project ini adalah untuk mengaplikasikan programmable logic controller (PLC) sebagai kontroller untuk mengawal fungsi-fungsi mesin tersebut. Komponen-komponen yang diperlukan dalam projek ini boleh dibahagikan kepada dua kumpulan iaitu komponen electrik dan juga komponen mekanikal. Antara komponen-komponen elektrik yang digunakan termasuk motor, suis, relays dan juga PLC controller. Komponen-komponen mekanikal yang digunakan pula adalah seperti valve dan juga struktur mekanikal mesin tersebut. Mesin tersebut adalah berupaya untuk memberikan makanan ikan dalam suatu jangka masa yang telah ditetapkan dengan menggunakan timer yang terdapat di dalam PLC. Selain itu, ia juga berupaya untuk menyebarkan makanan tersebut ke dalam kolam dengan menggunakan kipas yang telah dipasang pada satu luas kawasan yang telah ditetapkan. Oleh kerana mesin yang dibina ini merupakan sebuah mesin prototype, ia adalah dicadangkan bahawa sebuah mesin asal yang tulen dibina pada masa akan datang. Selain itu, system rangkaian PLC juga patut dikaji agar beberapa PLC dapat dikontrol serentak dengan hanya menggunakan sebuah computer. Pada konklusinya, projek ini amatlah berjaya kerana semua objectif berjaya dicapai dan mesin prototype yang terhasil berfungsi pada tahap yang memuaskan.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

An automatic fish feeder is a type of machine that allows the user to set the preferred time to allow the machine to automatically feed the fish at the specific time set. There are various ways to achieve this goal of allowing the user to set the preference time such as using an external timer, a timing belt and many others. This project involves designing and building a prototype of an automatic fish feeder for cultivation pond usage. This means that the basic concept of the machine is to able to feed the fish at a specific time set and also able to cover the whole pond area which comes in various sizes.

1.2 Problem Statement

The aquaculture farmer which uses the intensive culture has to be highly attentive because any mishaps would prove costly. The feeding time for the fish is very important for these farmers. Besides that, it is important to determine the amount of feed fed to the fishes. This is because it will affect the quality of the water and therefore can be disastrous. This means that the farmers would have to wake up early in the morning and stay up late in the night just to ensure that the feeding time is met. Besides that, continuous monitoring means that it is time consuming.

1.3 Scope of Project

The scope of this project is to create a machine which would automatically feed the fish at a certain time range which is set by the user. Besides that, the amount of feed for each feeding can be set to prevent any waste. The machine could also distribute the feed evenly into the pond to prevent the feed from gathering at only one spot. My project is also a major improvement over the current system which only allows the feed to drop at one particular spot in the pond.

1.4 Objectives

The objectives of this project are to:-

a) To design an automatic fish feeder for cultivation pond

The main aim of this project is to design an automatic fish feeder which is for cultivation pond usage. This involves using designing step-by-step methods which includes material choice, structure design and also controller programming.

b) To create a prototype of the designed automatic fish feeder

Another objective of this project is to manufacture the prototype of the machine designed. This means that an actual hardware would be built but in a smaller scale compared to the actual machine. Besides that, substitute components would be used for the prototype machine.

c) To use the PLC as a controller to the prototype machine

The last objective of this project is to apply the Programmable Logic Controller (PLC) as the controller for this machine. This is to help apply a new technology in one of the oldest sectors which is the agriculture sector. Besides that, it would also comply to the field of study which is in the automation field.

1.5 Project Definition

The word ‘automatic’ can be defined as to control or to operate by automation process. It is an adjective which comes from the word ‘automation’. The word ‘automation’ comes from an ancient Greek word which means *self dictate*. Therefore, ‘automation’ means to use control systems such as computers to control industrial machinery and processes, replacing human operators (IEEE Transactions on Automation Science Engineering).

The word ‘fish feeder’ in the title can be defined as an object or machinery used to supply food to the fish. Fish is water-dwelling vertebrate with gills that remains so throughout its life. Most are cold-blooded, though some, such as some species of tuna and shark, are warm-blooded. Taxonomically, fish are a paraphyletic group whose exact relationships are much debated (J.D. Hansen and A.G. Zapata, 1998).

The word ‘cultivation pond’ can be separately defined. The word ‘cultivation’ means the production of something which in proper terms here to rear fishes [Brady, Nyle C. and R.R. Weil, 2002]. The word ‘pond’ means small bodies of water, generally smaller than one would require a boat to cross. In other terms, ‘pond’ refers to small artificially created bodies of water. Therefore, the term ‘cultivation pond’ in the title can be defined as small bodies of water used to rear fishes.

Therefore, the title of this project can be defined as an object or machinery operated by the automation process which is used to supply foods to fish which are reared in small bodies of water.

1.6 Project Support Case

The agricultural sector in Malaysia is involved in the production, processing and waste management of crops, livestock and fishery. It has contributed significantly to the Malaysian economy. For the first 30 years after independence, the agricultural sector was the main contributor to the national economy. In 1980 it contributed RM10.2 billion or 23% of the Gross Domestic Product (GDP), dropping to 20% in 1989, to 13.6% in 1995 and to 8.2% in 2003. The agricultural sector attained an average growth rate of 3.2 per cent per annum for the period of 1985–1995, with the growth rate dropping from 5% in 1985 to only 2% in 1995. In absolute terms, the total value-added of the agricultural sector increased from RM11.9 billion in 1985 to RM17.1 billion in 1995 and to RM18.2 billion in 2000 (at 1987 prices).

For Malaysian agriculture to compete effectively in the global environment, it has to change from the current traditional method of farming and cottage-type agro-industry to modern commercial farms and factories. In line with this, the Third National Agricultural Policy (NAP3) has emphasized on the modernization and commercialization of the agricultural sector to lower production cost and to increase labor and land productivity. The applications of agricultural engineering technologies constitute the major aspects of this agriculture modernization.

Agriculture engineering is needed to serve as a catalyst or a pacesetter to stimulate growth in our agriculture and agro-based industry. At the same time, the industry must change in order to be able to make full use of agricultural engineering to respond to the changing demands of agriculture and society (JURUTERA, April, 2005).

1.7 Project Benefits

This project would bring a lot of benefits to the society especially on the agriculture sector. Among some of the benefits of this project are:-

a) Reduce cost

This project will help reduce the cost of aquaculture farmers. This is because by using this machine, they can reduce costs such as labor cost and also time cost. Labor cost is reduced because by using the machine, aquaculture farmers have the choice to employ fewer workers all around the clock just to tend their farms. This is because the machine is specially designed to feed the fish at specific time which are being set by the farmers according to the fish habits.

Time plays a very important part in any type of businesses in this world. Therefore, the aquaculture fields are also no exception. The time spent everyday by the farmers and their workers just to feed the fish can be greatly reduced by using this invention. This is because the farmers would not need to worry about feeding their fish with the machine which has the function of automatically feeding the fish at specific time. Therefore, the farmers can spend these times on other activities.

b) Improve agriculture sector

This project would help brings technology improvement in the aquaculture sector. The 'Automatic Fish Feeder' which will be designed is an improvement over some of the older designs. This would certainly give the agriculture sector a new look and also a step forward in the world of science and technology. My invention would help reduce cost and also increase productivity which directly means an increment in financial resources for the farmers.

This invention would also give a new look in people's perspective towards the agriculture field. This is because the agriculture field is considered as a

more traditional field compared to other sectors such as the manufacturing sector. This is because the agriculture sector is a bit behind compared to other sectors in term of technology. With this invention, we could change such negative perspective and therefore promote the agriculture field to the younger generation.

c) Increase productivity

By using the machine, the aquaculture farmer would be able to increase their productivity. This is because a proper feeding schedule would help increase the growth rate of the fish. This would then ensure that the fish's reared would be bigger in size and therefore has a better market price. Besides that, a proper feeding schedule would prevent any unwanted incidents which might occurred such as malnutrition and others that might occur due to the lack of food or unstable feeding time.

d) Encourage the growth of agriculture sector

As said earlier, this invention would help change the negative perceptive that the communities have over the agriculture field. This would therefore encourage the growth of the agriculture field or to be more specific, the aquaculture field. This is because the community would have a better view of the aquaculture field and also realize the potential marketability of this field.

Besides that, the invention would also open new market and also increase the productivity of the aquaculture sector. The money gained from there could be re-invested in the aquaculture field to bring more improvements and new technology towards the field. This would therefore help the sector to grow and become one of the leading income providers for the country.

e) Economy growth

Since our independence, the agriculture sector has always been one of the main income providers to the country economy. With the 'Automatic Fish Feeder', we can further spur this growth and therefore brings an economic

revolution to our beloved country. This is because the invention would increase productivity and this directly means an increase in income. This would therefore spur the economy growth in our country and indirectly means our country growth.

CHAPTER 2
LITERATURE REVIEW

2.1 Types of Fish

Fish are vertebrates which are like mammals, reptiles, amphibians and birds. They have a backbone and an internal skeleton. There are roughly 25,000 different types of fish. They come in all shapes and sizes and every possible color (The Columbia Electronic Encyclopedia, 2001-2005). Despite the enormous variety, there are common features. Most fish are cold-blooded and live in water. Besides that, fish have scaly skins which can be used as defense against predators. Fish breathe through gills and have fins and a tail which they use for swimming.

2.1.1 Groups of fish

The 25,000 known species of fish are divided into three main groups:-

a) Jawless fish (agnathas) – The great survivors

   The last survivors of the world's first vertebrate animals - their ancestors date back five billion years. Unlike younger species of fish, they do not have scales or jaws. Currently, there are only about 45 surviving species

   Examples: Lamprey, Hagfish

Figure 2.1: Lamprey [Journal of Great Lakes Research, v. 21, supplement 1, 1995]

b) Cartilaginous fish (chondrichthyes) – From sharks to rays

Developed about 100 million years later, the skeleton of these fish is made of cartilage, which is not as hard as bone. These fish have jaws, as well as teeth which are usually hard and sharp. Their bodies are covered with hard scales. Currently, there are about 600 living species

Examples: Shark, Stingray

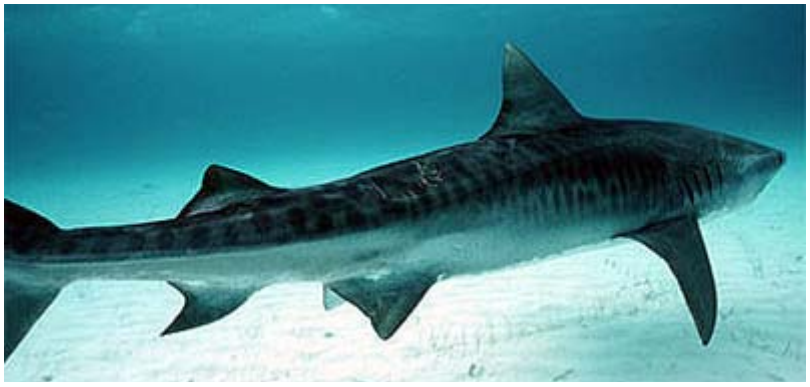

Figure 2.2: Shark [UI326 by Ryan Guckes, Tracy Hoorman, and Mike Whelan, spring 2000]

c) Bony fish (osteichthyes) – Most of the fish in the sea

Fish with bony skeletons appeared about the same time as cartilaginous fish. They are by far the largest group, with about 20,000 species alive today. These fish have an organ called a swim bladder to help them float.

Examples: Lionfish, Sturgeon, Butterflyfish

Figure 2.3: Lionfish [NOAA's National Centers for Coastal Ocean Science, Silver Spring, MD., USA]

2.2 Fish Pond

Basically, there are two kinds of aquaculture. The first type is the extensive aquaculture based on local photosynthetic production. The second type is the intensive aquaculture, in which the fish are fed with external food supply. The management of these two kinds of aquaculture systems is completely different (Department of Aquaculture, Wageningen University).

a) Extensive aquaculture

   The limiting factor for fish growth here is the available food supply by natural sources, commonly zooplankton feeding on pelagic algae or benthic animals, such as certain crustaceans and mollusks. The photosynthetic production can be increased by fertilizing the pond water with artificial fertilizer mixtures, such as potash, phosphorus, nitrogen and micro elements. Because most fish are carnivorous, they occupy a higher place in the food chain and therefore only a tiny fraction of primary photosynthetic production (typically 1%) will be converted into harvestable fish.

   As a result, without additional feeding the fish harvest will not exceed 200 kilograms of fish per hectare per year, equivalent to 1% of the gross photosynthetic production.

A second point of concern is the risk of algal blooms. Temperatures, nutrient supply and available sunlight are optimal for algal growth. When provided with these, algae multiply their biomass at an exponential rate. This will eventually leads to an exhaustion of available nutrients and a subsequent die-off. The decaying algal biomass will deplete the oxygen in the pond water and pollute it with organic and inorganic solvents which can lead to massive loss of fish.

In order to tap all available food sources in the pond, the aquaculturist will choose fish species which occupy different places in the pond ecosystem (Donald R. Swift, 1999).

b) Intensive aquaculture

In this kind of systems, fish production per unit of surface can be increased at will with a clause that as long as sufficient oxygen, fresh water and food are provided. Because of the requirement of sufficient fresh water, a massive water purification system must be integrated in the fish farm. A clever way to achieve this is the combination of hydroponics horticulture and water treatment. The exception to this rule is cages which are placed in a river or sea, which supplements the fish crop with sufficient fresh water. Environmentalist objects to this practice.

The cost of inputs per unit of fish is higher than in extensive farming, especially because of the high cost of fish food which must contain a much higher level of protein (up to 60%) than a balanced amino acid composition. This frequently is offset by the lower land costs and the higher productions which can be obtained due to the high level of input control.

Essential here is aeration of the water, as fish need a sufficient oxygen level for growth. This is achieved by bubbling, cascade flow or liquid oxygen.

When fish densities are high, the risk of infections by parasites like fish lice, fungi, intestinal worms, bacteria, and protozoa is much higher than in the

animal husbandry because of the ease in which pathogens can invade the fish body. The same holds for water pollution or depletion of oxygen in the water, which can ruin a fish crop within minutes. This means, intensive aquaculture requires tight monitoring and a high level of expertise of the fish farmer (William McLarney, 1990).

2.3 Types of Cultivation Pond

Fish are raised commercially in a few types of cultivation pond with each having its own advantage and disadvantage depending on the types of fish reared and also the environment factor. Below are a few of the most popular culture settings for a cultivation pond.

a) Cage

Today, cage culture is receiving more attention by both researchers and commercial producers. A factor such as increasing consumption of fish, some declining wild fish stocks, and poor farm economy has produce a strong interest in fish production in cages. Cage culture also offers the farmer a chance to utilize existing water resources which in most cases have only limited use for other purpose (Michael P.Masser, 1988).

Figure 2.4: Cage pond [The Aquaculture Information Network Center]