i-Feeder

(Intelligent Feeder)

by

Durrussaadah bt Mohamed Azam Zaki

6492

Dissertation submitted in partial fulfillment of
the requirements for the

Bachelor of Technology (Hons)

(Information and Communication Technology)

Universiti Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

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January 2008

CERTIFICATION OF APPROVAL

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Approved by,

____
(Ms. Norshuhani Zamin)

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January 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

____

DURRUSSAADAH BT MOHAMED AZAM ZAKI

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ABSTRACT

The objective of this project is to develop a remote and automated feeding system based on fish behaviour for aquaculture industry. In conventional pond management, fish feeding time is fixed to some schedule and is done by workers or done by scheduled feeding mechanism. Furthermore, major problem such as increasing of fish fatality rate will occur due to abundant feed. For this study, a focus will be given on developing a prototype for a pond system by monitoring the feeding management, feeding management is control based on fish behaviour together with input gathered from infrared sensor. The system is aimed to intelligently minimize the food wastage, usage of labour forces thus increase production rate. Given foods abundantly to fish will lead to over feed, poor water quality, affect fish mood and give extra-load to mechanism that is used in maintaining water quality, such as aerators. Feeding management is great successful if it is an automated feeding when the fish is hungry and stop when the fish is satiated. This project will use waterfall methodology consisting of preliminary investigation, analysis and planning, design, development, testing and implementation.

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CHAPTER 1

INTRODUCTION

1.1 Background study

Aquaculture remains as the world's fastest growing food production sector. It is currently a major source of employment and foreign exchange revenues generator for many developing countries. Aquaculture: The Next Best Alternative (2005), it was found that aquaculture sector contributed 30.78% and 34.65% to world economy. As for in Malaysia, this industry is an important sector and plays a significant role in the national economy by contributing to the national Gross Domestic Product (GDP). Malaysia Prime Minister (2007),as launched by Prime Minister Datuk Seri Abdullah Ahmad Badawi, Aquaculture Industrial Zone (ZIA), a high impact project that could contribute of RM 6.3 billion by 2010, this is major project in terms of providing job opportunities with high income to participants and opening new businesses in the fisheries industry.

Intelligent Feeder System (i - Feeder) is a project inspired by the K-Perak 2010 vision to draw on ICT as the foundation to remake Perak's economy and thereby improve the social-economic standing of State and also the income of the community of fisherman. Intelligent Feeder System (i - Feeder) is a remote monitoring system for monitoring fish feeding system of aquaculture ponds. The Remote Monitoring System (RMS) control the on and off process, and report the update to the owner's personnel phone for observation at a remote location via GSM network through Short Messaging Service (SMS) once the feeding process reach one (1) cycle. One cycle is defined as timestamp of feeder being on and off back. These conditions are monitored through digital sensors which are connected to the RMS.

1.2 Problem Statement

In conventional pond management, fish feeding time is fixed to some schedule and is done by workers. If the workers overfeed the fish, it will leads to major problem. Whenever fish is under stress, living in poor health or poor water quality, they tend not to eat the pellet. Uneaten pellet will sink to the bottom of the pond, being decomposed and pollute the water. Fish life cannot be sustained in polluted environment and this accidentally increases fish fatality rate.

Some of the ponds management nowadays is more advance where they have scheduled feeder. This automatic feeder work based on scheduled. It will turn on feeder based on the specific timing and off based on the specific timing too. As for example, tilapia feeding time is set at 8.00 am to 10.00 am. The feeder will continue giving food to the fish even if the fish is already satiated and only will turn off at 10.00 am. This is actually wasting the pellet by dumping it into the ponds without need. Thus, water quality destroyed too.

In addition, rot pellet will produce fertilizer and help algae blooms faster. Algae can only alive in polluted water. As the result, it gives extra work load to mechanism to maintain water quality and subsequently increase production rate. The high activities of maintaining water quality will decrease equipment's lifespan and increase energy usage. Norshuhani Zamin et.al (2007) stressed out that from the observation at some local farms, a sudden equipment failure can cause heavy losses to the farmers. A worse case was informally recorded that a farmer lost RM150K (~USD 43K) due to the malfunction aerators.

1.3 Objectives and Scope of Studies

The objective of this project is to implement a remote monitoring and control system for feeding management via GSM in an aquaculture industry that is able to maximize food consumption and improve water quality by reducing food wastage. For this study, a focus will be given on developing a prototype for a pond system by monitoring feeding system which is based on fish behaviour. The feeder will only turn ON when the fish is hungry and turn OFF when it is satiated.

Taking the rapid growth of wireless technology today as a new opportunity, we design a wireless telemetry based system where multiple farms can be monitored and controlled via GSM network from a single location. We proposed an unmanned operation for remote farms where the feeding data can be captured periodically. The acquired data can be made to trigger the feeder mechanism when certain threshold value is reached. The system helps to schedule and automate the feeding process by giving the fish a right amount of food for optimal feed assimilation. This helps to reduce food wastage and control the water from being polluted.

CHAPTER 2

LITERATURE REVIEW

Boudreau (2002) says that among the main target of today's research is on telemonitoring applications. Although aquaculture has undergone considerable growth for the last thirty to forty years especially in developing countries however no research have proposed remote monitoring and control system on fully automate feeding system.

Nikmal Technology (2007) has developed computer-based system for fish farming plants. The system is a tool to increase of fish growth efficiency and to enhance the ecology around the place of fish farming. System managed to reduce feed wastages by feeding on the base of estimation of fish feeding activity. The system responds in real time basis, to all reasons excite a stress in fish and affect on the fish appetite. Fish will get the right amount of feed at any condition, and will provide best conversion ratio. Sensor and data collection module comprised of a DSP acquisition board (DAQ) is used to give best input to the system.

Furthermore, See View (2006) is designed to provide farm operators with the ability to feed multiple cages simultaneously. AQM takes advantage of existing onsite underwater video camera equipment and builds on operator knowledge learned from observing and distinguishing uneaten feed pellets using these cameras. Proprietary computer control software monitors multiple underwater cameras and tracks feed pellets moving across the monitor screen in exactly the same manner as a farm operator. Uneaten feed pellets are identified on the video screen, time stamped, logged and saved for review. Operators can authorize SeeView to directly control the feed gate on the feed broadcaster at the camera location.

However, Akvasmart (2006) is one step ahead by using more complex and efficient system. Akvasmart offers a smart system that can detect uneaten pellet below the fish eating area in the cages. Pellet sensors include both Doppler and IR sensor is complete package in detecting uneaten pellet. All pellet sensors, camera systems and environmental sensors are connected to the feed control base via wireless control systems (CVU or CSU). Some cameras can also be connected to portable monitors or hardwired camera network systems if practical. Infrared sensors are use to measuring the rain of pellets passing through the confines of a collection funnel below the feeding zone. When pellet frequency reaches a critical point, indicating satiated fish, and feed supply can be terminated.

C.M Chang et.al (2004) proposed and develops an intelligent feeding controller for indoor intensive culturing of eel. The system is fixed to the schedule. The beauty of this system is where, it terminated feed supply when photoelectric sensor detects signal below threshold value. This helps in reducing problem that occurred in traditional scheme and device. Based on the system developed, eel eating times are scheduled at the machine at 8.30 – 10.30am, 11.30 – 1.30 pm, 2.00 – 4.00 pm, 8.00 – 10.00 pm. The feeder will turn on based on the scheduled time, and the continuity of the feeding process is being decided by photoelectric sensor. Photoelectric sensor is used to detect fish movement on water surface. Data logger is used to store data recorded such as accumulative impulse signal triggered in 30 seconds. The decision made to continue or stop feeding is based on accumulative impulse signal in 30 seconds should be equal or greater than threshold value consecutively 3 times. Figure 2.1 shows the flowchart of the system.

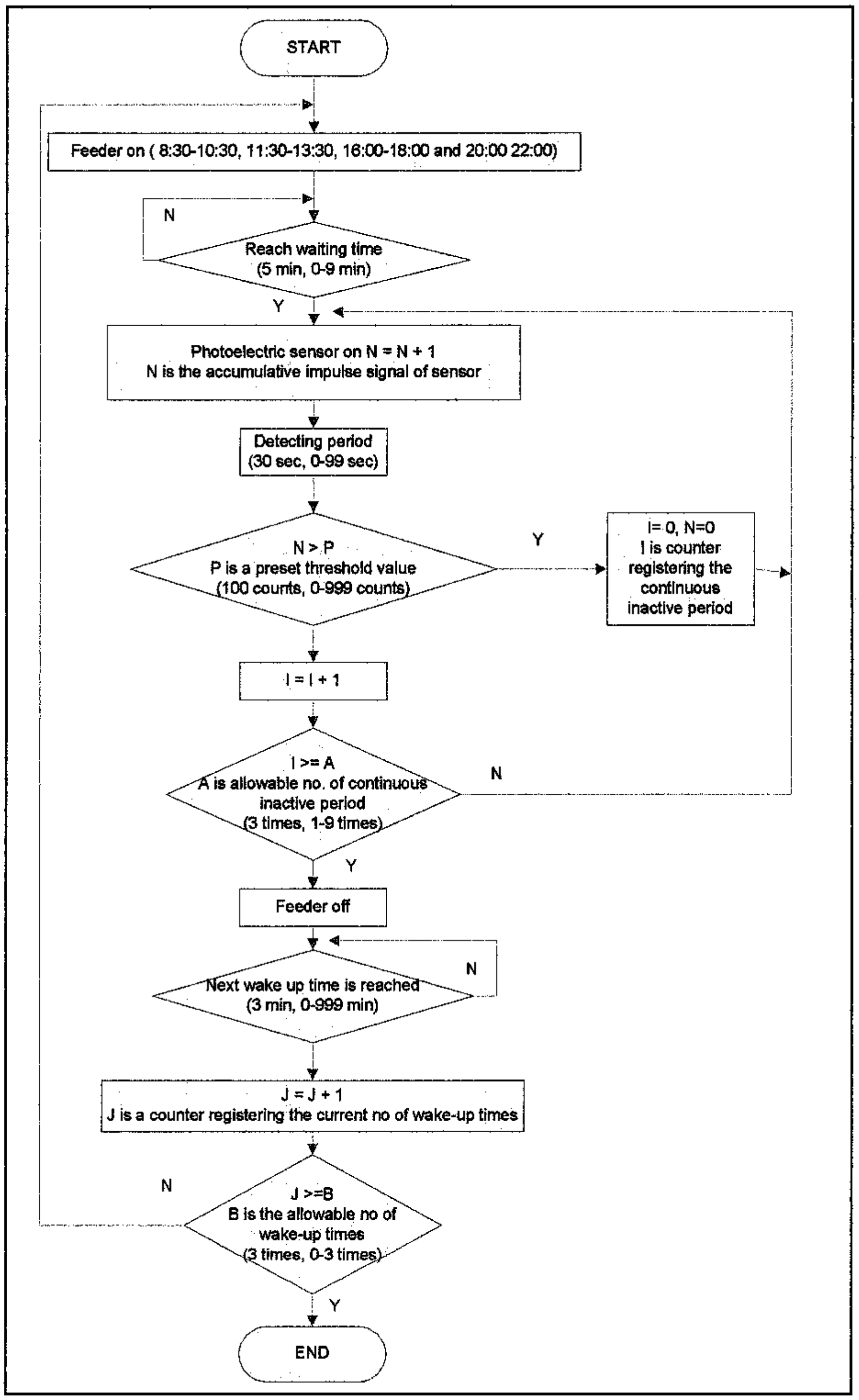


Figure 2.1: Solution by C.M Chang et.al (2004)

Colin Ware et. al. has study on foraging behavior of humpback whales. Whales are dying of so many reasons such as ship collisions and entanglements with fishing gear ever-increasing numbers. By understanding the behaviors, could lead to changes in shipping regulations or in the nature deployment of fishing apparati. The digital recording acoustic tag,1 shown in Figure 2.2, is the key technology used to see underwater whale behavior. Digital Tag (DTAG) is a recording device containing several instruments. Three axis accelerometers provide information about the gravity vector's direction, three axis magnetometers measure the direction of the earth's magnetic field, a pressure sensor provides depth information, and a hydrophone continuously records sound. The digital recording acoustic tag (DTAG) is attached to a whale using suction cups.

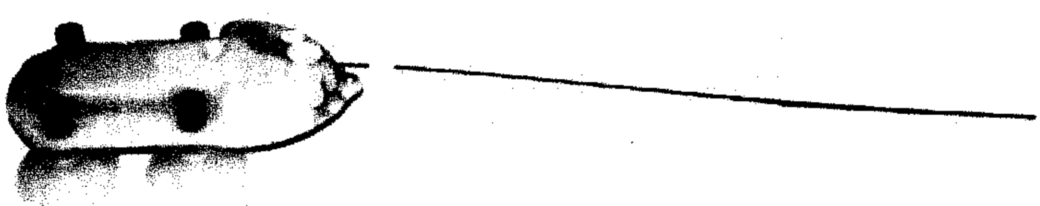


Figure 2.2: Digital Recording Acoustic Tag (DTAG)

Data telemetry is an important characteristic in remote monitoring system. Telemetry is a technology which allows the remote measurement and reporting of information of interest to the system designer or operator. All of the projects above used various methods for data telemetry, SeeView ™ uses wireless network to transmit the data collected at the remote area to the central system. The Open Ocean Aquaculture program on the other hand opt the satellite radio approach to transfer its collected data to the shore. The GSM (Global Standards for Mobile) network is yet another area currently being ventured by many for remote monitoring through its Short Message Service (SMS) application.

Short Message Service (SMS) is a mechanism of delivery of short messages over the mobile networks. It is a store and forward way of transmitting messages to and from mobiles. The message, which is text only, from the sending mobile is stored in a central short message centre (SMC) which then forwards it to the destination mobile. This means that in the event the recipient is not available, the short message is stored and can be sent later. Each short message can be no longer than 160 characters. These characters can be alphanumeric or binary Non-Text Short messages. An interesting feature of SMS is return receipts. This means that the sender, if wishes, can get a small message notifying if the short message was delivered to the intended recipient. Since SMS used signalling channel as opposed to dedicated channels, these messages can be sent/received simultaneously with the voice/data/fax service over a GSM network. SMS supports national and international roaming. Thus, SMS message can be sent to any other GSM mobile user around the world. With the PCS (Personal Communications Service) networks based on all the three technologies, GSM, CDMA (Code Division Multiple Access) and TDMA (Time Division Multiple Access) supporting SMS, SMS is more or less a universal mobile data service.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

In developing this project, Intelligent Feeder System (i - Feeder), Waterfall methodology has been identified as the most suitable. There are six (6) phases in waterfall model which are preliminary investigation, analysis & planning, design, development, testing, and implementation.

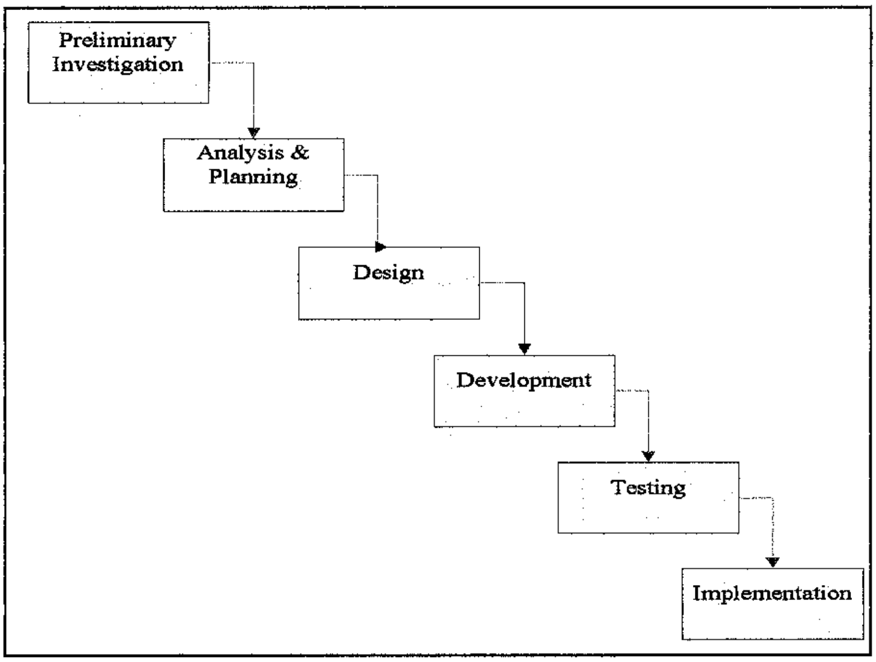


Figure 3.1: Waterfall model

3.1.1 Preliminary Investigation

In preliminary investigation phase, most of the research and data mining will be done through the internet, aquaculture books, and research papers. Common problems or issues regarding the maintenance of an aqua farm will be identified as well as traditional and current trend in aqua farming feeding system techniques. From the research done, it is identified that poor feeding management will lead to major problem, which are wasted feed, poor water quality, higher energy usage and increase fish fatality rate.

3.1.2 Analysis & Planning Phase

From the gathered data, important features of the system to be developed are identified. Conventional feeder management requires the worker to manually and constantly feed the fish based on schedule, and more advanced technique is used where the feeder is on and off based on schedule.

However, the conventional feeder management will not give an effective and accurate estimation of pellet. By giving fish a right amount of food helps in maintaining water quality, and stabilized aqua system. Moreover, at a large-scale pond, feeding the fishes will require a lot of resources and cost. The system to be developed will:

- Schedule the time to turn on the feeder.
- Enable ponds owner to monitor their fish feeding system remotely via GSM
- Feed the fish when the fish is hungry and stop when fish is satiated.
- Alert the owner in case of emergency: the feeder is not operating correctly

More, i - Feeder will incorporate many advanced features and functions. Thus, the system needs to be designed in such a way that it is flexible and allows connectivity to other command and control information system.

3.2 Design Phase

As general, Figure 3.2 describes the overview of the system design. An automated feeding system is connected to the workstation and mobile phone through the GSM network. This implementation allows managers to monitor the feeding system virtually anywhere within the cellular coverage. Since Malaysia government made a policy for a nationwide cellular coverage by the year 2003. Thus, the system will take advantage of the existing infrastructure for data telemetry.

The system will consist of sensors for input and mechanical output as shown in Figure 3.3. Radial Infrared sensor will be used to detect fish movement on water surface. Feeder will be used as pellet container, and will be will turn on only when fish is hungry and turn off when fish is satiated automatically based on input triggered by infrared sensor. Proper action will then be taken based on the result. A message SMS will be sent to the manager to alert on the situation for further action. Specifically, message SMS will be sent when the feeder is turn on and off back. If the manager has not received any update, further action can be taken, to check whether the equipment is having problem, and manually feed the fish.

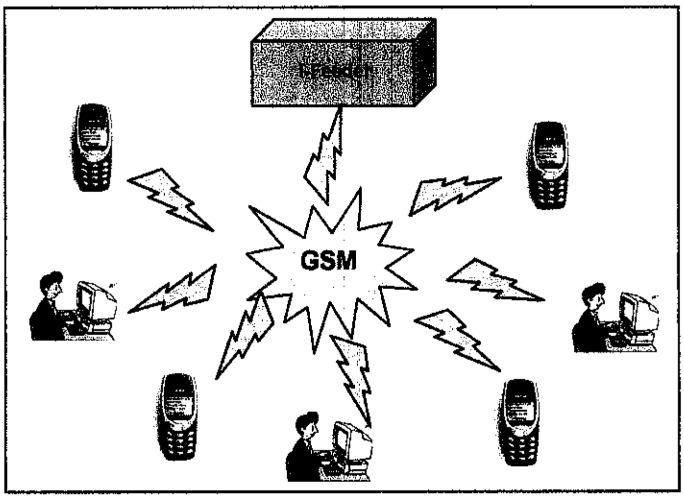


Figure 3.2: i-Feeder Overview

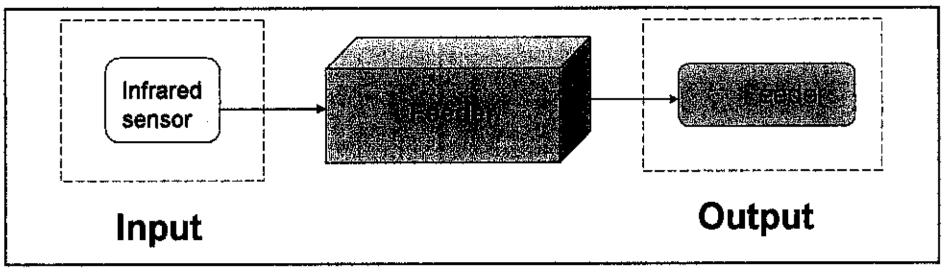


Figure 3.3: i-Feeder input/output

In designing i-Feeder, which is based on fish behaviour, rules and theory of fish behaviour towards food is being researched. Based on the facts, the algorithm is derived.

According to Marine Fish (2005)
Feeding fish is quite simple. Keep in mind that in nature fish eat constantly. You are better off feeding many small amounts of food to your display 20 times a day rather than overfeeding once a week. All food added to the display should be consumed within 30 seconds. Do not add so much food so that 3-5 minutes later it is seen floating around in the water. A key point to keep in mind is that with most fish, its stomach is relative to the size of its eye. It will not take much food to fill its stomach. However, most fish have a quick metabolism. Therefore, it is usually best to feed a very small amount several times a day.

Following the research done on the natural fish behaviour, this system will assume 30 seconds as the optimum feeding checking time. Feeder will start operating once a command received, infrared sensor is being triggered by signal and off when signal detected is below than threshold value. It is better feeding small amount of food frequently rather than overfeed once a week. With quick metabolism, fish is easily got hungry and craving for food. As the result, only required pellet is given to the fish.

According to Aquaculture Technology (2001)
If feed is supplied when the fish are hungry, they will rise to the surface, descending when their appetite has diminished.

With the statement above, infrared sensor is chosen to be the most suitable equipment to detect signal on water surface. Signal detected when there is movement on water surface. If feed supplied, and the fish is hungry, they will rise to surface, and a lot of signal will be transmitted to RMS. The feeder will be controlled by signal detected by infrared sensor. If the signal detected is more and equal to preset value, the feeder will remain at on stage, and if the signal detected is less than preset value, feeder will turn off automatically.

It is found that fish is 'dummy', but they can be trained. In this system, ideology of fish comes to food, but not food come to fish is used. A cane will be placed on the water surface and is used to block pellet from moving outside of radius. This is to prevent food come to the fish. Fish will learn that to eat food, they have to come to the right place. Radial infrared sensor will be able to detect signal within the radius. Figure 3.4 shows system structure at pond site.

According to Zainudin Idris from Trek Agenda Sdn. Bhd,

A very good pellet will floating on water surface , and will take 1 to 2 hours before going down while a bad pellet takes 5 minutes before going down. To make the system more workable and efficient, good quality of pellet will be used, for that to be lasted for 1 or 2 hours long on water surface.

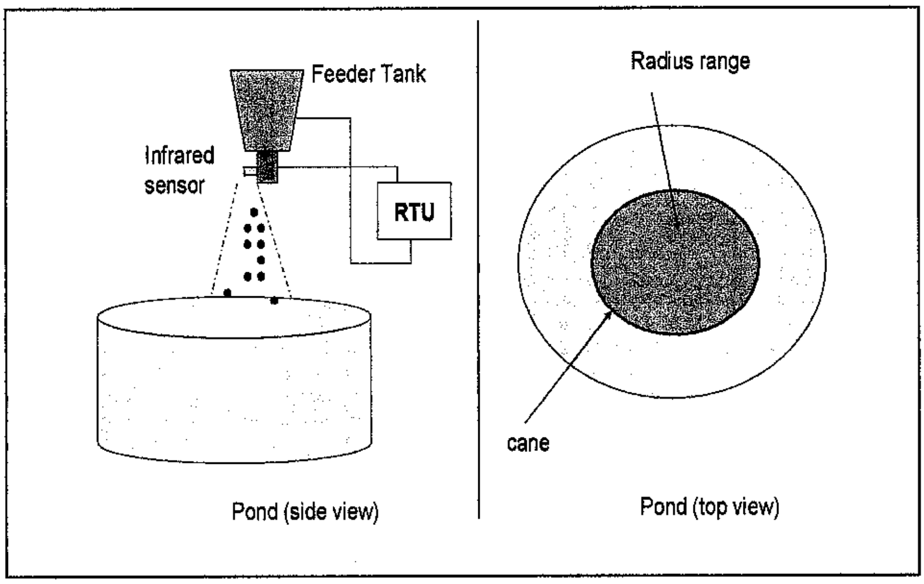


Figure 3.4: Pond's side & top view

3.2.1 Algorithm

<u>Flowchart</u>

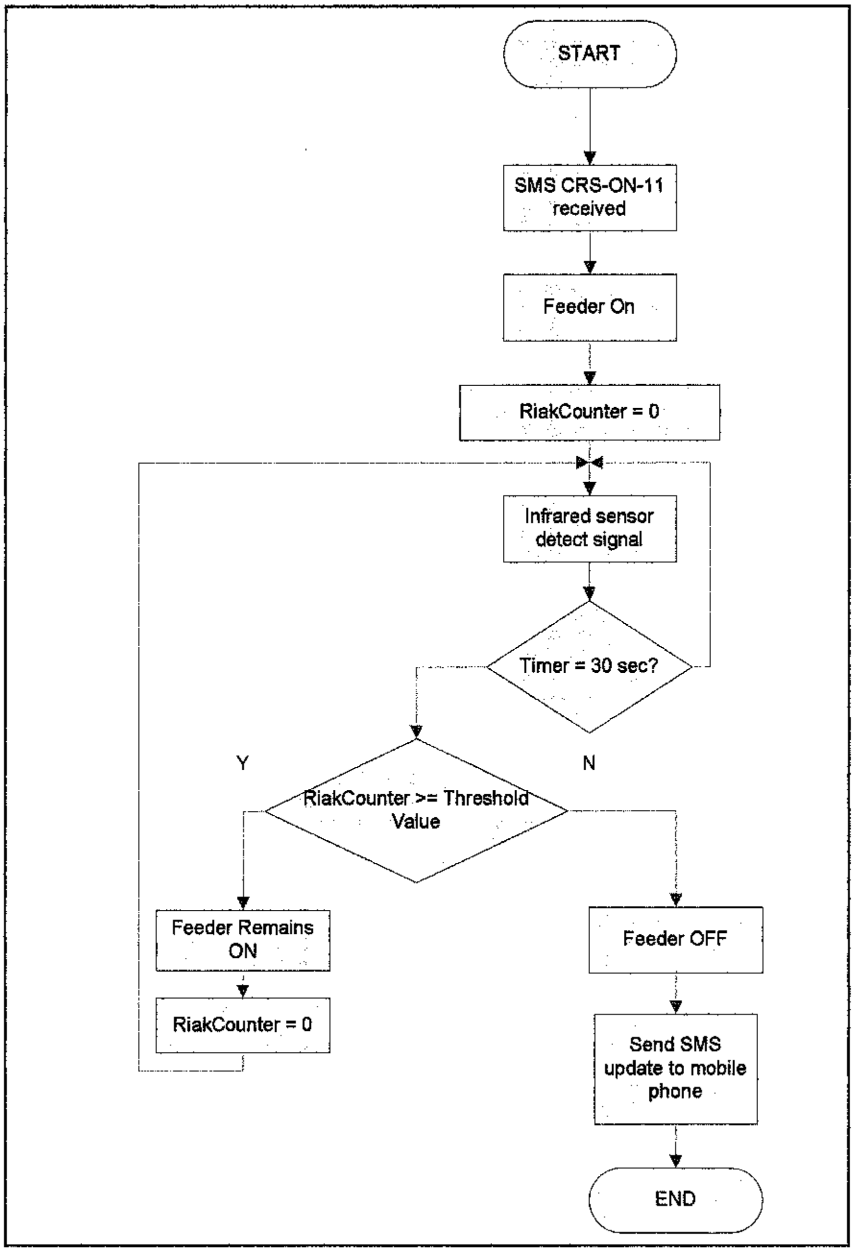


Figure 3.5: i-Feeder flowchart

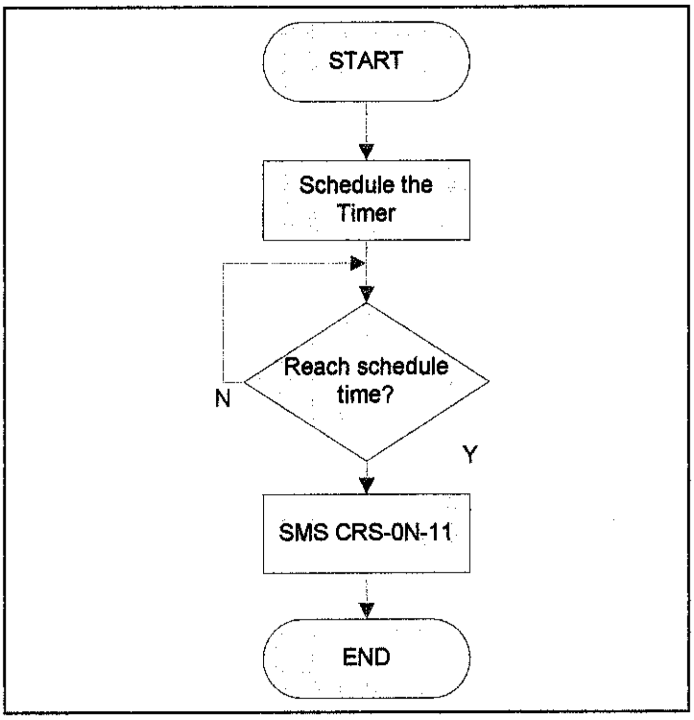


Figure 3.6: i-Feeder interface flowchart

To configure the system, user can do the scheduling on i-Feeder interface. i-Feeder will do frequent checking with the task added to the system in 500 seconds of timeframe. If the tasks added reach the real time, i-Feeder will send SMS to the RTU to turn on the feeder at the pond. Time checking is done continuously until there is not task to be performed.

The system is set to be idle at most of the time, at standby (feeder is OFF) state to detect signal. Riak Counter and Timer are always set to be **zero**. Once command CRS-ON-11 received, the RMS will on the feeder which is at digital output point 11. The Riak Counter sets to zero, the accumulated signal detected in 30 seconds will be compared with threshold value. If it is bigger than or equal to threshold value, the feeder will remain on, otherwise, the feeder will turn off. If the feeder still at on, the system will go through the same procedure again – detecting signal and comparing with threshold value until at one time accumulated signal detected is lower than threshold value, by then, the feeder will turn off. Signal is triggered by movement made by fish in radial area. More movement, more signal triggered. System will update to central station and mobile phone. The concept of movement detection was adopted from idea of C.M Chang et.al (2004).

Use Case Diagram

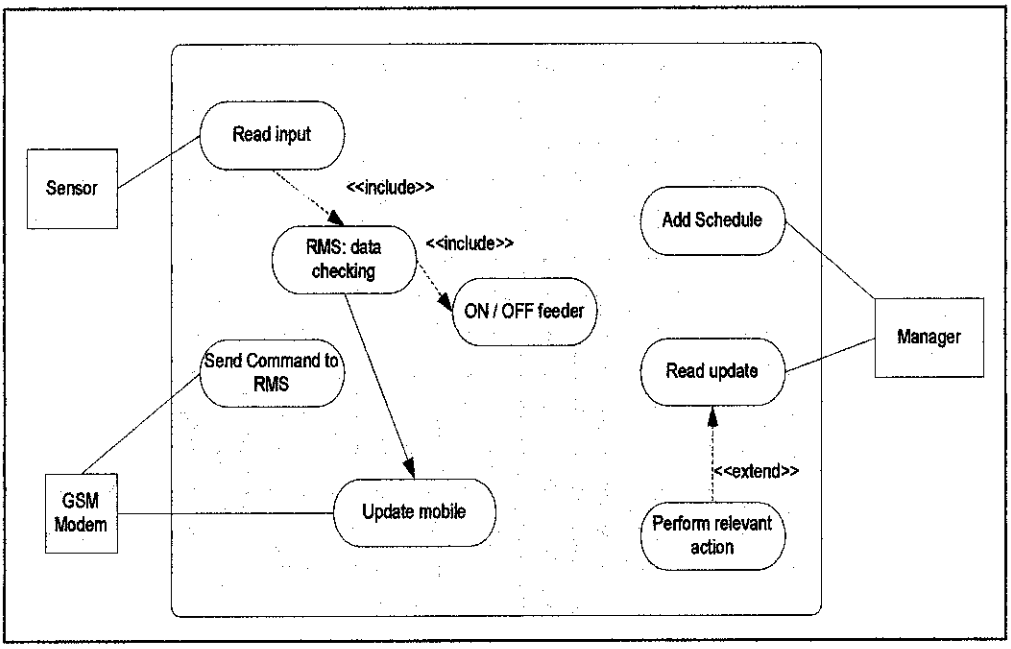


Figure 3.7: i-Feeder Use Case diagram

The system is performed by three important actors, which are sensor, GSM modem, and manager. Each of it will be performing their own tasks. A Command is transmitted to Remote Monitoring System (RMS) through SMS, RMS will turn on the feeder, and the sensor will start detecting signal and accumulated it. The accumulated signal detected will be as final decision whether to remain on or off.

Next, system will update the latest change to personnel mobile phone. As for manager, the actions are to read the update that is available in central station or personnel mobile. The manager will perform relevant action related to it. If the manager does not receive any update for a few hours, they can check the ponds, whether the hardware system is facing trouble

3.3 Development Phase

The development phase consists of three parts: hardware design, hardware system and software system.

Hardware Design

The hardware system of i-Feeder will consist of a remote monitoring system (RMS), input sensors and feeder as mechanical output. The hardware design phase will focus on interfacing the sensors and feeder with the monitoring system. Following will be the hardware used for the development:

1. Compact Remote System (CRS-844)

i-Feeder developed will be interacting with the CRS-844, which is developed by the Neural Manufacturing (M) Sdn. Bhd. for the purpose of data collecting from remote sites. CRS-844 is a single controller device with powerful processing features for data management and monitoring applications. It has 8 digital inputs, 4 digital outputs and 4 analogue inputs. It can support a maximum of 8 sensors per CRS. For this system, point number 4 and 5 will be used as input and output.

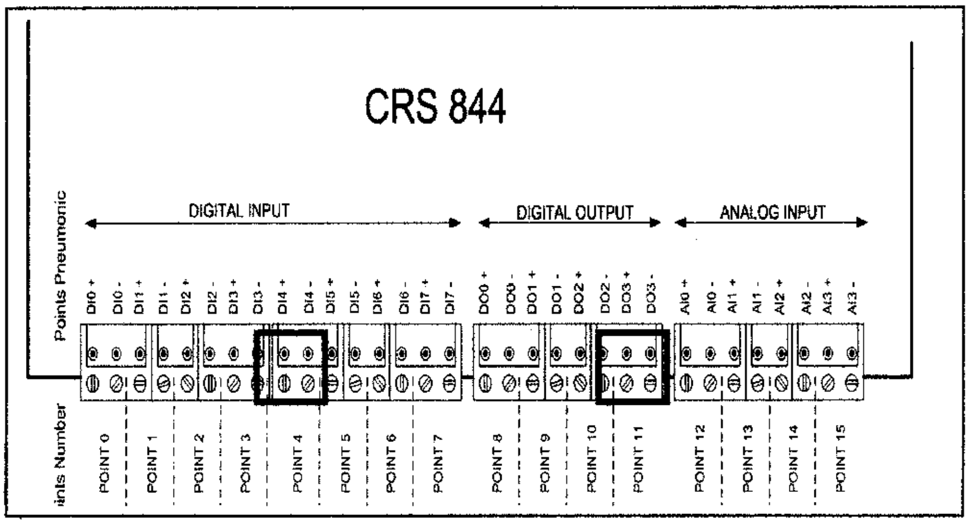


Figure 3.8: CRS Digital input/output and Analog input

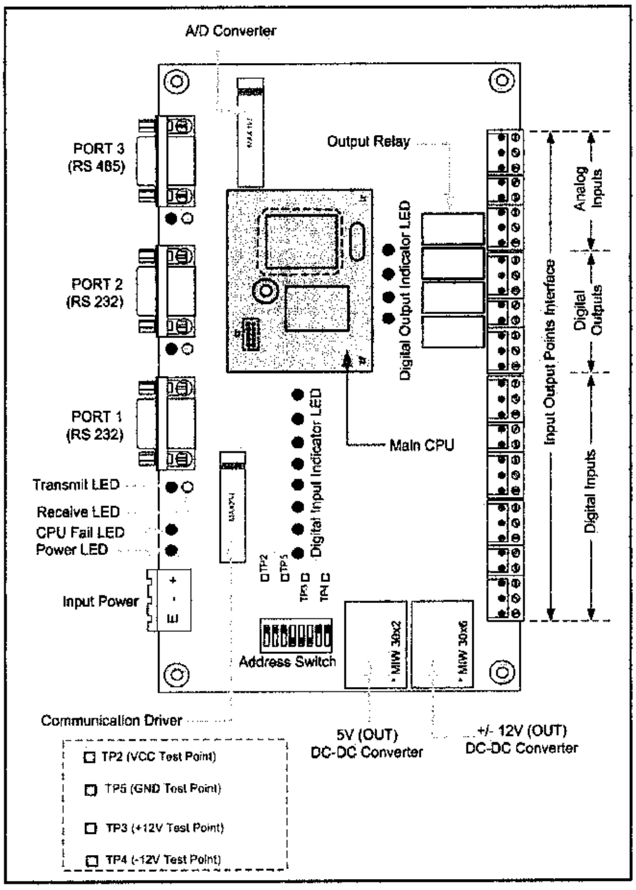


Figure 3.9: CRS Overview structure

2. *GSM Modem*

A GSM modem is a wireless modem that works with a GSM wireless network. The system will be using it to interact with the CRS. For the development, i-Feeder will be using Siemens MC35i GSM Modem. It supports extended AT commands which are defined in the GSM standards. With the extended AT commands, it can be used for:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

MC35i terminal features include:

- Dual Band EGSM900/GSM1800
- GPRS
- Data, Voice, SMS and Fax
- CSD up to 14,4 kbps
- Supply voltage range 8V.....30V
- Low power consumption
- Industrial interfaces
- Operating status LED
- Easy to integrate
- Full Type Approval GSM Phase 2/2+
- Dimensions: 65 x 74 x 33 mm

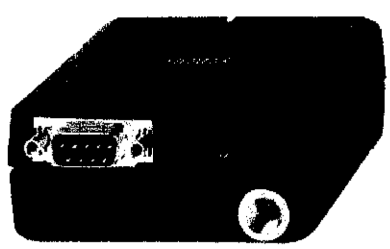


Figure 3.10: Siemens GSM Modem

3. Sensors

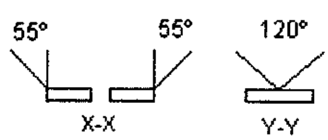
Digital sensors for monitoring purposes are connected to the CRS through its digital input. CRS has external sensing voltage from 12 to 110 VDC. If a signal coming in to a particular input, the LED will turn ON, indicate that there is input coming in.

a. Pyroelectric Infrared Radial sensor

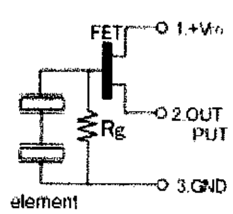
The pyroelectric infrared radial sensor detects infrared radiation on the basis of the characteristics that the polarizations of radial infrared sensor changes with fish movement. If there is movement on water surface, the sensor will detect the movement and send an input to CRS-884.

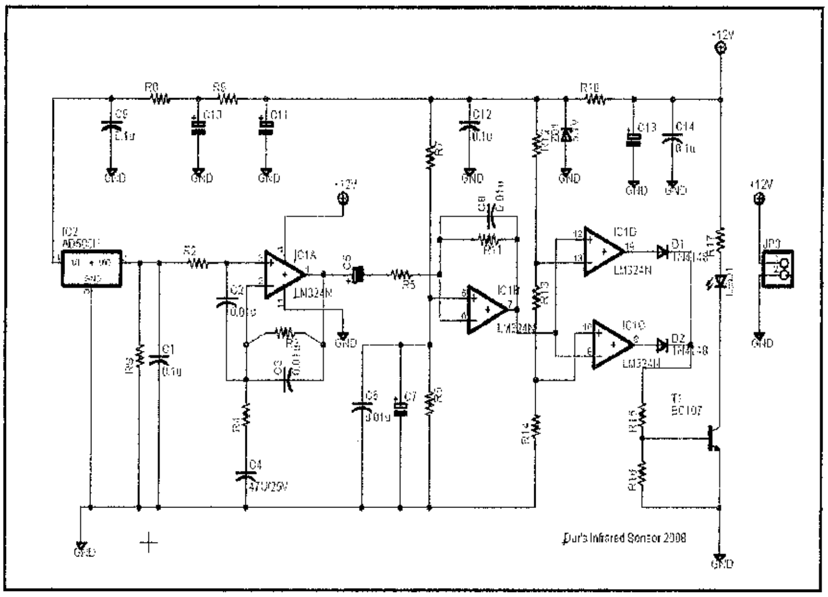
Below are the specifications and dimension of the Pyroelectric Infrared Radial Sensor being used for the system:

Recommended Model	: D203B
Encapsulation Type	: TO-5
IR Receiving Electrode	: 2×1mm, 2 elements
Window Size	: 5×3.8mm
Spectral Response	: 5-14μm
Transmittance	: ≥75%
Signal Output [Vp-p]	: ≥3500mV
Sensitivity	: ≥3300V/W
Detectivity	: (D*) $\geq 1.4 \times 10^{8}$ cmHz$^{1/2}$/W
Noise [Vp-p]	: <70mV
Output Balance	: <10%
Offset Voltage	: 0.3-1.2V
Supply Voltage	: 3-15V
Operating Temperature	: -30-70°C
Storage Temperature	: -40-80°C
Field of View	:



Equivalent Circuit :





Source:Bizschip Component

Figure 3.11: IR Sensor Schematic Diagram

The above hardware designed is expected to detect fish movement on water surface. Digital input received will be accumulated in 30 seconds. If it reaches or over threshold value, feeder will remain on, and off if not.

4. Feeder

A simple feeder is used in the system. The feeder will turn on and off based on the instruction given by the system.

Hardware System

Programming part is done at CRS-844 Rabbit Processor where Dynamic C Programming Language is being used. All the instruction of points actions are embedded in the processor. The CRS system is connected to monitoring station (Personnel Computer) through Port 1 (RS232). Port 1 is configured as Main Communication Port. It is configures as DCE with RX, TX and GND signal connection. For downloading codes purposes, 9-pin female connector of the Rabbit programming cable is plug into an available serial port.

In normal operation of CRS, PORT 1 is the main communication channel to Master System. PORT 1 DB9 (Female) connector, is configure as Data Terminal Equipment (DTE), with Receive, Transmit and Ground pin connection. PORT 2 is normally configured as secondary communication channel whereby in some cases CRS system has to perform concurrent data reporting to two separate Monitoring Stations. It is also a diagnostic communication port where user interface is design on Window's HyperTerminal program.

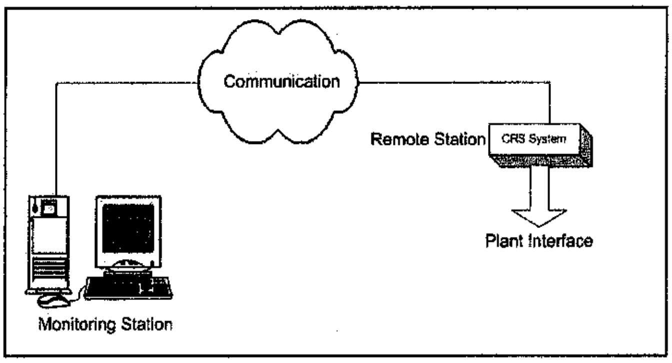


Figure 3.12: Basic CRS System interface

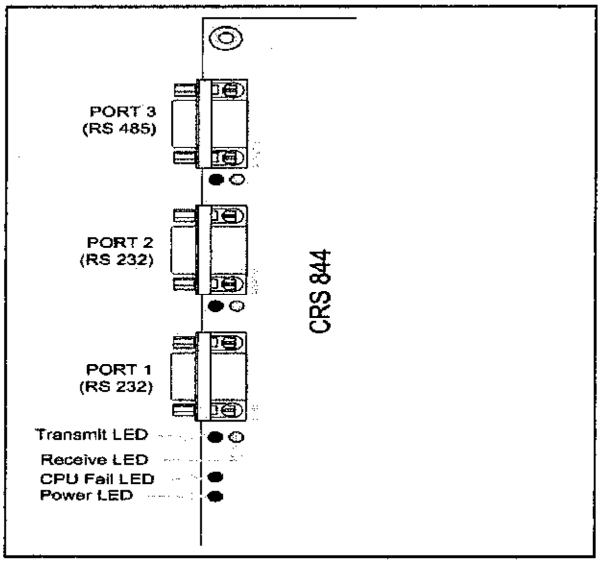


Figure 3.13: CRS connection ports

Software System

Software system provides user with graphical user interface (GUI) in order to do scheduling to on the feeder. User will be able to access the system from their personal computer. I-Feeder will send instruction CRS-ON-11 based on schedule. This command will be sent through SMS from the software system. User can schedule task by time (in minutes) or day. **Appendix A.1**

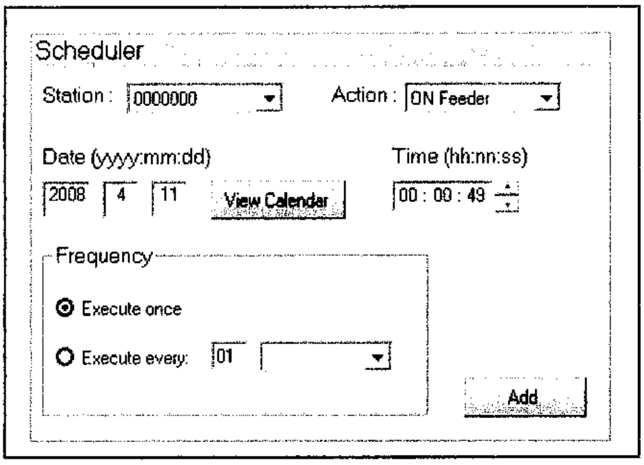


Figure 3.14: i-Feeder scheduler interface

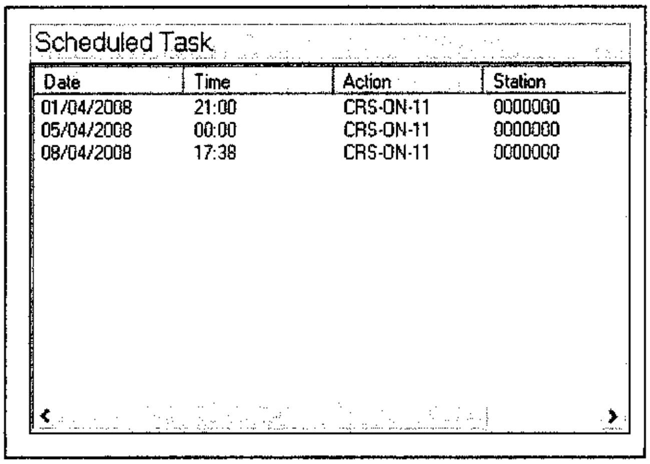


Figure 3.15: i-Feeder scheduled task interface

3.4 Testing

Intelligent Feeder (i-Feeder) Plant Testing

Two important elements being tested for the system are:

- Food consumption and water quality
- Operational cost (installation, maintenance)

Food consumption and water quality

Introduction

i-Feeder prototype is being tested at fish pond located in Chemor, Perak. The targeted fish was Tilapia with the total of 2,000 to 3,000 fishes per pond. The pond size is about 20 to 30 feet width and 5 to 6 feet depth. As for the prototype testing at real plant, threshold value of 150 is used as condition to on the feeder.

Objective

1. To test the sensitivity of the radial infrared sensor upon fish movements and ensure the functionalities of the prototype are fully working.
2. To compare the efficiency between i-feeder and conventional systems in term of food consumption and water quality

Procedure

1. The RTU is being set up at the pond where the Radial Infrared sensor is facing water surface with distance of 1 meter.
2. The CRS-844 system is turned on and the 'Reset' button was pressed.
3. A SIM card was inserted into the both CRS-844's GSM modems.
4. A command SMS is sent by i-feeder based on the scheduled.

Result

1. i-feeder sent a command SMS to RMS as per scheduled, and RMS turn on the feeder.
2. The LED at Digital Input point number 4 is turned on if the Radial Infrared sensor detects fish movement on water surface. This indicates that the incoming signal is accept as an input to CRS-844.
3. In the duration of 30 seconds, the sensor detects more incoming signals, and the feeder remained on.
4. Once the fish is satiated, the fish is descending to the bottom of the pond.
5. Incoming signal detected is lesser than threshold value, and the feeder is being off intelligently based on fish behaviours.
6. A report SMS is sent to registered mobile phone.

Table 3.1: SMS send and reply

SMS Message	**CRS Reply**	**Remark**
CRS-0N-11	CRS POINT 11 ON	A command to turn on the feeder.
CRSMU-RTC	TIME SYNCHRONIZE COMPLETED	Synchronize RTU time
-	FACTORY (<factory id>) Single Feeding Completed Start: <Date:day/month/year>:<time:hour,minutes,second> End: <Date:day/month/year>:<time:hour,minutes,second> Example: FACTORY (00000000)	Message received at registered personal phone once 1 cycle of feeding is done.

	Single Feeding Completed Start: 09:04:2008:08:00:05 End: 09:04:2008:09:35:45	

Parameters below are fixed to each types of feeding testing:

Pond Size	
Width	20 to 30 feet
Depth	5 to 6 feet
Fish	
Type	Tilapia
Amount	2,000 - 3,000
Pellet	
Type	

The result of this testing will be discussed in the Chapter 4: Result & Discussion

Operational cost (installation, maintenance)

Objective

1. To compare operational cost between conventional systems and i-Feeder.

Procedure

1. Interview sessions being conducted with the owner of the ponds.

The result of this testing will be discussed in the Chapter 4: Result & Discussion

3.5 Implementation

The final step in waterfall model would be the delivery of the system to the user. The system will be put online for user to configure the schedule. Figure 3-6 describe the whole process of the system. The feeder is able to be on through i-Feeder system or through SMS. Based on the instruction received, Remote Monitoring System (RMS) will turn on the feeder, and the sensor will determine the continuity. A SMS is sent to registered mobile phone as update.

For example, as per scheduled feeder turn on at 8.00 a.m, i-feeder will send command SMS to RMS. RMS will turn on feeder, the sensor will start counting movement of fish, it will turn off once the fish satiated. RMS will send a message to update user with timeframe of feeding on and off.

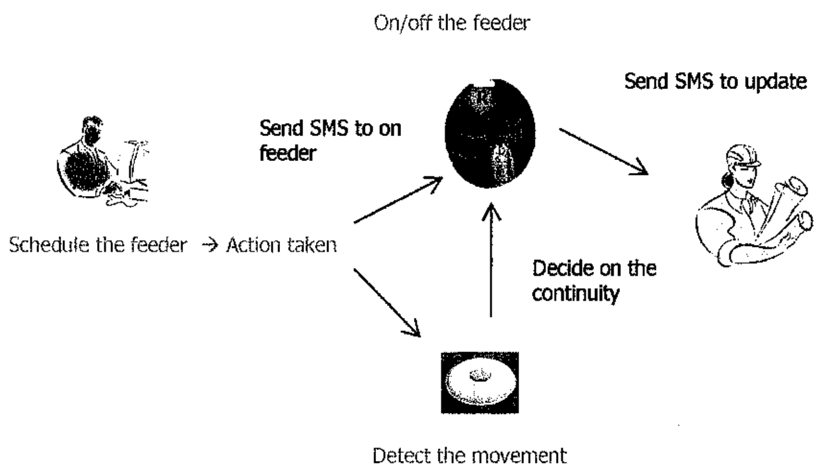


Figure 3.16: i-Feeder implementation

CHAPTER 4

RESULT AND DISCUSSION

4.1 Findings

Fish is just like other creatures, it have shyness, mood, certain behaviour towards food, predator and its friends. Fish mood will be changed from time to time, it become stress if the water quality is not good enough to main it's living. Just like human being, fish cough! If fish cough, it is actually representing that poor water quality.

With stomach size relative to the size of eyes, fish actually cannot consume a lot of pellet at one time. However, they have quick metabolism to digest the food. If fish is deadly hungry, food added to the display should be consumed in 30 seconds. It is good to feed fish with a small amount, but frequently. If feed is supplied when the fish are hungry, they will rise to the surface, descending when their appetite has diminished. Fish is actually stupid, but they can be trained. If you keep giving it food at the same time consecutively, they will learn that it is time for them to eat!

Fish also have a very good smell capability, where some fish can detect smell of the food from far away. With the good smell sense, they have no problem to look for food. Holly Trueman, Amy Johnston (2007) discover that over the last decade, an undercurrent of research reveals that fish are intelligent social animals that learn from direct experience and by watching how other fish behave. Using complex communication systems, they enjoy long memories and pass cultural knowledge betweengenerations.

4.2 Results

4.2.1 Experiment: A day with fish

Student has done an experiment with the fish, which is called 'A day with fish'. 10 fishes with 2 different types (tiger fish and oascar fish) were being tested in medium size aquarium. Below are the experimental results:

- A fish will eat a very small amount of pellet (two to four pellets)
- It will rise to the surface when food is supplied and diminished when they are satiated.
- Uneaten pellet will ruin water quality
- Fish is moving in the form of group
- Fish consumed pellet in 30 seconds or less if they are hungry

From the results achieved, we can conclude that, the findings are true, and can be used as a valid theory for this system.

4.2.2 Ponds visit.

Several ponds in Kuala Kangsar areas have been visited. From the interview session with the owner, Mr Mohd Hafidzi, student noticed that in some areas the management of the ponds are fully man-controlled. The feeding process is manually done by worker based on schedule, and given by the worker around the pond. It is noted that, fish will appear to the surface if the oxygen is insufficient enough. Ikan patin and tilapia appeared to be the most suitable fish using this system. This is because both type of fish mentioned have a good eating habit where they will stop once they are satiated. Different with catfish, this fish will not stop eating as long as food is supplied, and die because of that.

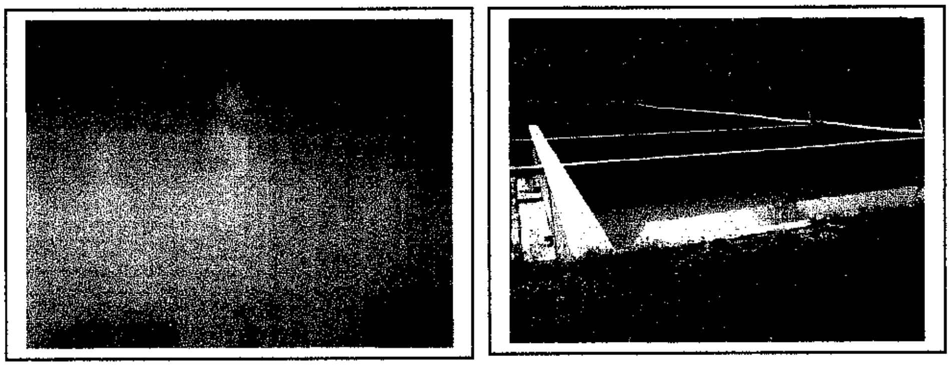


Figure 4.1: Ponds

4.3 Discussion

Pond testing: Food consumption and water quality

Testing made to compare and identify which system performs the most best. The three systems being compared are manually, scheduled machine and i-Feeder. The testing is done at same place but in different days.

For the manually feed system, at 8 am and 4 pm, the owner feed the fish, by walked around the ponds to ensure all the fish get the food. The total foods supplied are about 6.5 kg, and at the end of the process, it is seen that a lot of pellet not being consumed by the fish and floating on the water surface. After a while, water quality attributes: pH and DO are being measured to identify the effect of overfeeding to the water quality.

For the scheduled machine, we scheduled the machine to be on at 8.00 to 9.30 am and 4.00 to 5.30pm, the feeder is turn on and off based on the timer. At 9.30 am and 5.30pm, it is seen that a lot of pellet not being consumed and floating on the water surface. The total foods supplied are about 8.0 kg. Also, the uneaten pellets are more compared to manually feed. pH and DO of the water is measured after that. For the i-feeder system, the feeder is turn on based on scheduled at 8am and 4 pm, RMS receive a command message and turn on the feeder. The feeder is being off when less movement detected on the water surface. The total foods supplied are about 4.8 kg. pH and DO of the water is measured too.

From the testing done, it is proven that i-Feeder gives user much benefits especially when it supply optimum pellet needed only and maintain water quality to the best state.

Table 4.1: Comparison of manual, scheduled machine and i-Feeder food consumption and water quality

Manual				**Scheduled Machine**				**i-Feeder**			
Time	Food (Kg)	Water Quality		Time	Food (Kg)	Water Quality		Time	Food (Kg)	Water Quality	
		pH	Do			pH	Do			pH	Do
8.00 am	3.5	6.7	6.8	8.00 - 9.30 am	4	6.4	5.2	8.00 am	2.6	11	7.5
4.00 pm	3	6.45	6.0	4.00 - 5.30 pm	4	5.0	3.5	4.00 pm	2.2	8.9	7.2
Total	**6.5**				**8.0**				**4.8**		

Water quality

According to Optimal Water Quality Standards for Aquatic Ecosystem, pH is the measurement of hydrogen ion concentration while DO is the measurement of oxygen dissolved in the water. The pH values in most freshwater ponds range from 6 to 9. It is a dynamic water quality variable which fluctuates throughout the day. The optimal pH value for aquatic ecosystem is between 6.5 and 8.5.

Based on the general water quality standards for aquatic ecosystem, the measurement used for the simple evaluation method are:

pH Levels:

- 0 to 6.4 → Acidic
- 6.5 to 8.5 → Neutral
- 8.6 to 14 → Basic

DO Levels:

- 0 to 3.4 → Fatal
- 3.5 to 6.9 → Poor
- 7.0 to 8.0 → Good

<u>Pond testing: Operational cost (installation, maintenance)</u>

From the interview conducted with pond owners or worker, the costs being measured are food supply, farm maintenance, labour, electricity, SMS service, and equipment maintenance per month.

Table 4.2: Comparison between manual, scheduled machine and i-Feeder operational cost and maintenance

Item	Cost (RM) per month			Remark
	Manual	Scheduled Machine	i-Feeder	
Food	295.00	360.00	220.00	High quality food
Farm Maintenance	180.00	180.00	180.00	Remained -supply calcium n etc
Labour	1600.00	800.00	800.00	RM 800 per head
Electricity	500.00	1000.00	350.00	Equipments
SMS Service	-	-	50 - 100	5 cents per sms
Equipment Maintenance	800.00	1000.00	650.00	Equipment lifespan
Total	**3375.00**	**3340.00**	**2300.00**	

The studies show that typically the operation cost of the reasonable size aqua farm can be reduced by as much as 30. Note that the bulk of reduction is in electricity usage and the labor cost. Not much electricity needed to control i-Feeder equipments. Two labors were made redundant by this automated system thus saving a cost of RM1600.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

The i-Feeder project is aligned with the K-Perak 2010 vision to draw on ICT as the foundation to remake Perak's economy and thereby improve the social-economic standing of State and also the income of the community of fisherman. i-Feeder will revolutionize aquaculture industry in Perak by automating the management of aqua farm system and reducing the cost and learning curve of managing an aquaculture farm. With i-Feeder, activities can be done remotely via GSM network. Moreover, production rate can be yield by reducing the mortality rate and cost of labor.

For recommendations, further enhancement of the system can be made to increase its effectiveness. Some of the enhancement will involved the expansion of the system scope.

1. **Integrate i-Feeder System with Intelligent Aqua Farm System via SMS (IAFS)**- i- Feeder will take part in feeding management while IAFS monitor pH and DO of the water. With combination of the two systems together will increase the efficiency and usability of monitoring pond.

2. **Use .NET as a platform** – For the current system, Visual Basic is used as platform to develop the system. However it will be at it most beneficial if .NET use used as platform. With .NET, the accessibility to the system can be expanded not only through the GSM network but also via the Internet.

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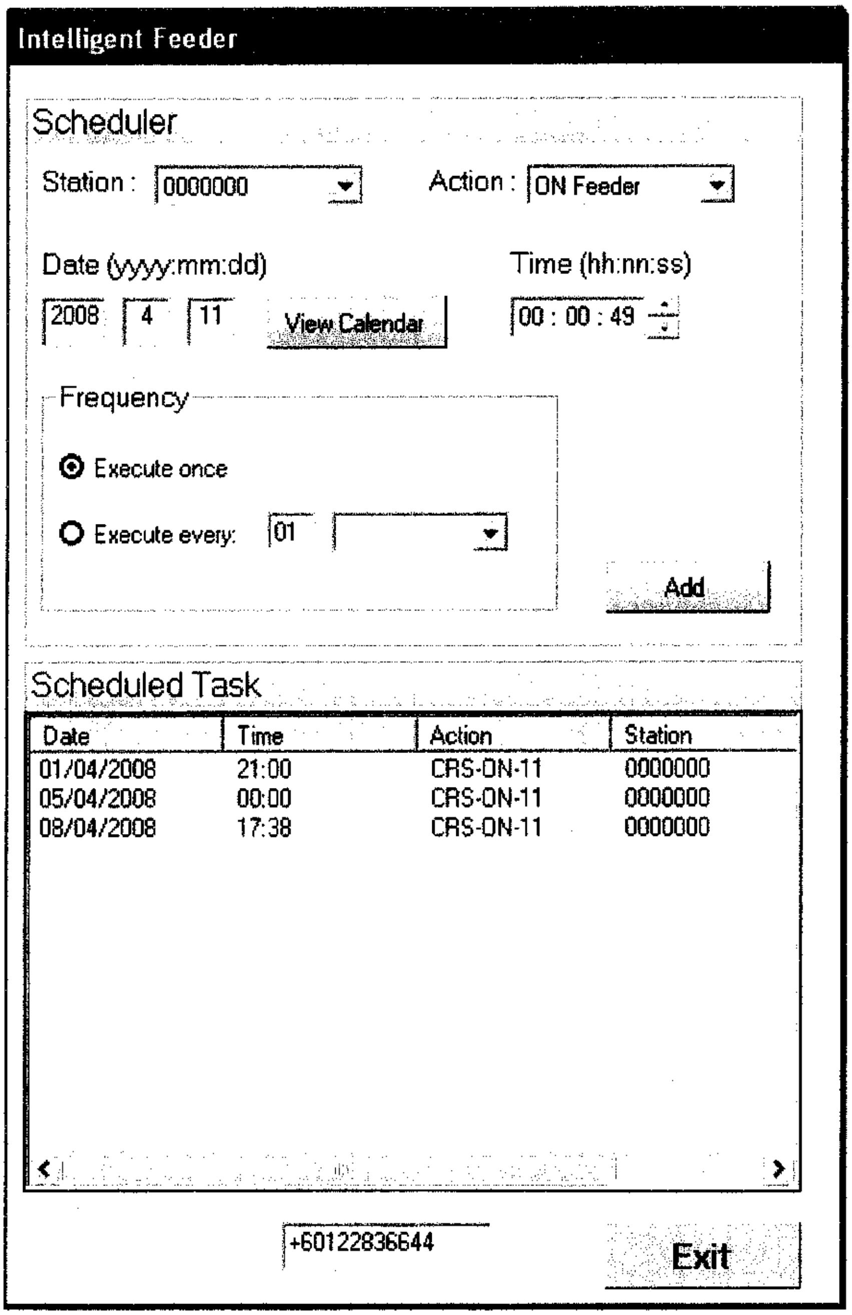
APPENDIX

A.1


Intelligent Feeder
Scheduler
Station : 0000000
Action : ON Feeder
Date (yyyy:mm:dd)
2008 4 11
View Calendar
Time (hh:nn:ss)
00 : 00 : 49
Frequency
Execute once
Execute every: 01
Add
Scheduled Task
Date Time Action Station
01/04/2008 21:00 CRS-ON-11 0000000
05/04/2008 00:00 CRS-ON-11 0000000
08/04/2008 17:38 CRS-ON-11 0000000
+60122836644
Exit