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Dual Band RFID-Based for Optimizing Arowana Breading

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Abstract-- *Arowana has made the highest contributor to the country's ornamental fish with export contribution RM24 millions in 2014. Government expected to contribute a minimum of RM600 million to the gross domestic product by end 2020. An intelligent device is imperative for cost effective to monitor and control the production environment in real time manner. The government encourages developing the best Arowana breeding method. Thus, Arowana farm demand in detecting the active male Arowana to ensure Arowana breeding process is efficient. Arowana farm suffered losses of RM360,000 for 1 fish in a month and time wasted because the reader falls off hands and drowned when the workers are trying to detect the Arowana due to the existing handheld is not intelligent enough and short of capability over water detection for implant tags. The main purpose of this research is to design and develop the intelligent portable reader by using embedded RFID technology that capable to detect the active male to be segregated because the active male will incubates eggs in the mouth and rise to the surface at night. Arowana is a carnivorous fish therefore before the eggs hatch, the active male mouth brooders must be segregated from other Arowana. The fry are faced with the threat from other Arowana if not segregate. Thus, an intelligent radio frequency (RF) portable reader meets the active male mouth brooder detection demand from Arowana farm with the capability of detecting implant tag from outside of the water area. The developed prototype shows that the capabilty of detection for the outdoor setting, it was observed that the maximum distance between the two nodes for the power level of*

P0 was 160 meters.

Keywords-- *embedded system, RFID, intelligent system, Arowana applications.*

I. INTRODUCTION

In Malaysia, Arowana fish farming activities are also conducted on a commercial basis for export to international markets, and between the agencies involved is the Department of Fisheries. In nature, these fish breed once a year, in June and August in its original habitat (Department of Information, Ministry of Communications and Multimedia, 2008)[1].

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Arowana fish or *Scleropages* formousus is a type of ornamental fish is very popular and quite pricey. Due to widespread fishing activities since the 70's until now, the number of population in the wild is decreasing and extinction. Because of this fish species have been protected as a species for import and export controls under the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Department of Information, Ministry of Communications and Multimedia, 2008).

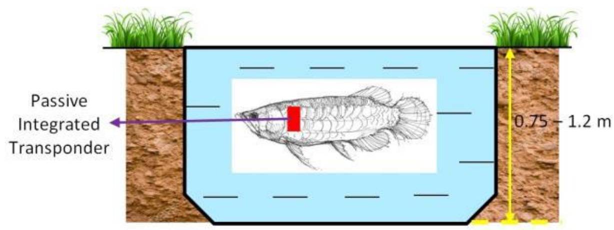

Figure 1: Fish pond depth

Figure 1 shows suitable form of fish pond is a rectangle with a gradient ratio tire 2:1. An appropriate area is between 0.2 - 0.4 ha with a water depth of 0.75 - 1.2 meters. The bottom should be flat and slopes toward the water drain out. The wide of ponds in between 20 to 30 percent of the total pool are encouraged to ensure adequate water supply sources and water treatment process is carried out when necessary[2].

Meanwhile, the supply to meet market demand is still low. This is due to a lack of knowledge arowana fish farmers in Malaysia on arowana fish breeding properly. Arowana fish is a fish that can live high resistance to half a century or more[3][4].The high demand for a limited supply of natural causes needs to be made, to control the exploitation of the environment. Arowana fish is a freshwater fish that has the physical properties of the exotic[5]. Therefore, arowana fish used as ornamental fish have a high economic value and attractiveness, especially to the group of ornamental fish lovers who want to make arowana fish as pets and their collections. The outline of the paper describe about of design methodology and result of real world testing.

II. BACKGROUND OF THE STUDY

Internet of Things (IoT) is a global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilitie [6][7]. It will offer specific object identification and connection capability as the basis for development of independent cooperative services and applications, which is characterized by high degree of autonomous data capture, event transfer, network connectivity and interoperability.

According to the IEEE Journal OF Internet of Things, an IoT system is a network of networks where, typically, a massive number of objects, sensors and devices are connected through communications and information infrastructure to provide value-added services via intelligent data processing and management for many different

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applications[8][9]. For example, Radio Frequency Identification (RFID), Zigbee and Wireless Sensor Network (WSN) are used for wireless communication among diverse systems. In addition, The Internet of Things of European Research Cluster (IERC) provides a succinct definition of IoT, stating that it is a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols, where physical and virtual “things” have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the [10][11].

In this regard, the characteristics of RFID serve as a prerequisite for the IoT. Admittedly, RFID is not new technology since it has been popularly used in the early twentieth century. The popularity of RFID lies in its practicality in a wide variety of applications. As such, it can virtually provide almost limitless potentials for future applications. Specifically, RFID technology can be efficiently used to monitor manufacturing products that constantly moving and have low visibility [12]. Hence, it is not surprising that the use of RFID technology has been pervasive in many industries. More specifically, the technology has almost been fully utilized in the ornamental fish industry, in view of the diversity and unique of products that need to managed efficiently.

III. DESIGN METHODOLOGY

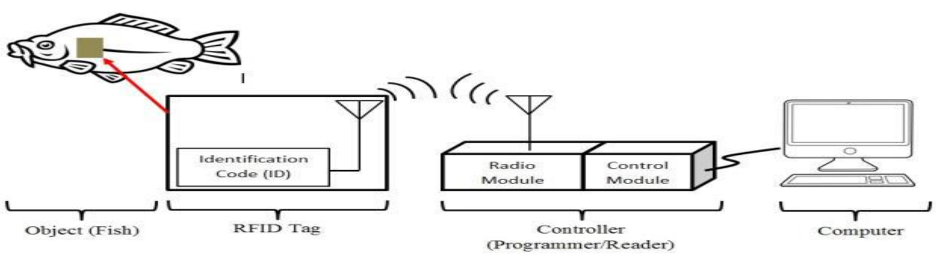

Figure 2: Passive RFID System

Figure 2 shows a complete system for fish monitoring system. The block diagram is divided based on parts. There are four different parts in the systems which are tagged object, passive RFID tag, RFID reader (controller) and computer (display unit).

The tagged object in this proposed system is fishes or specifically Arowana fish. The purpose of selecting Arowana fish is because this type of fish is very expensive and it is a protected species.

There are two types of RFID tag which are passive and active tag. Passive tag is suitable in monitoring Arowana fish because the passive tag will be implant in the fish. For years, fisheries biologists have proven the potential of passive integrated transponder (PIT) tags in providing accurate measurements of the growth, survival and movement of individual fish because PIT tags a small, inert and require no battery therefore can easily last the life of tagged fish [13][14][15].

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Controller consists of 6 key components which are radio module, microcontroller, PC interface, power supply, antenna and Liquid Crystal Display (LCD). Radio module will locate the transponder and receive a unique serial number from the transponder. Microcontroller will process the ID and send it for display on LCD or PC.

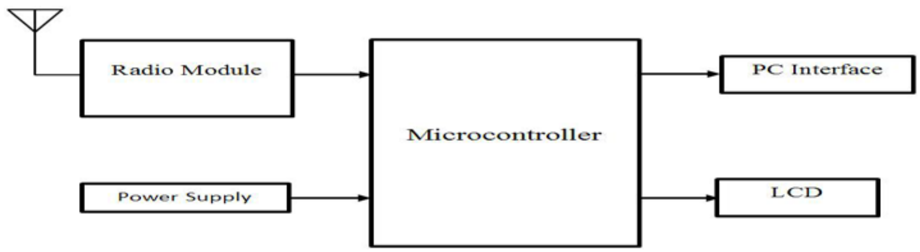

Figure 3: Key Component for Controller

IV. Result and Discussion

In this paper, two measurement was carried out. The first involved measuring the Received Signal Strength Indicator (RSSI) level based on the changes in the distance between two nodes.

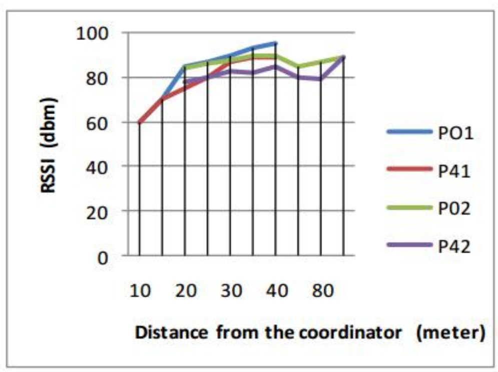

Figure 4: The measurement of RSSI based on the transmiting power level of P0

This measurement was carried out for the various transmitting powers of a remote node and a coordinator node. Based on the non-line-of-sight (NLOS) setting, the coordinator node and the remote node has been placed inside and outside of a laboratory in the management building of Arowana Farm respectively. The initial distance between the two nodes was set at 20 meters. Subsequently, this distance was incrementally increased by 10 meters by moving the remote node away from the coordinator node.

The second involved the measurement of the latency of real-time detection. Specifically, the identification packet latency of a packet was measured from the time it was generated by a portable RFID reader to the time the reader sent command data to a tag. For this outdoor test, the RSSI levels were measured by varying the distance between the two nodes by 20 meters based on the line-of-sight setting, which covered the recommended range of

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distance for UHF transponder [16][19]. Inevitably, for such outdoor test, many factors might have reduced the coverage range, such as the height of radio antenna, atmospheric conditions, terrain sensitivity, reflection, absorption of signals, and interference[17[18]. The measurement of RSSI (for both outdoor and indoor scenarios) based on the transmitting power level of P0 and the energy consumption of the proposed reader module are shown in Figure 4 and Figure 5 respectively.

The results showed that the operations carried out, such as transmitting, receiving, idling, and sleeping, drew different amounts of current, thus giving rise to different power consumption. In addition, the power levels of RF in transmitting data were different. In this study, the power levels were set by entering the AT commands on the PL register or on the configuration panel. Figure 5 shows the setting parameters and values of the four power levels.

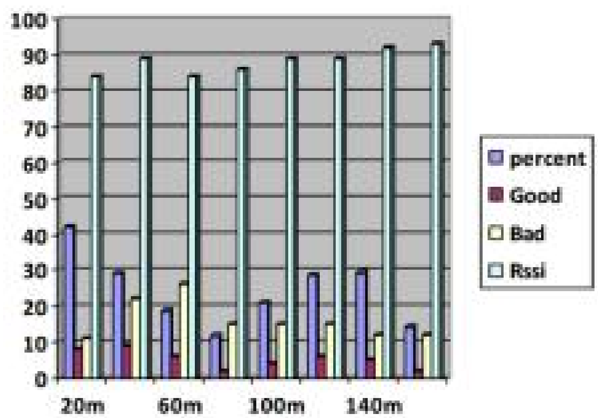

Figure 5: The detection results based on different power levels

Node 1: PL=4: 10dBm, PL=0:2dBm

Table 1: The detection coverage range based on power levels

Power Level	Indoor coverage range.	Outdoor coverage range
P0	40m	160m
P4	44m	220m

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Arguably, this finding may be attributed to a number of factors, such as signal obstruction due to the presence of trees and people. Obviously, such factors can complicate the implementation of a WSN. This drawback may have an adverse impact on many applications (e.g., agricultural application), as the system module will normally be set at the power level of P0. One way to turn around such a problem is to place such a monitoring system on a place slightly higher than the objects (e.g., crops)[21][22]. Alternatively, the transmitting power of the system can be raised to P4, which had been demonstrated to be able to cover a wider distance of 220 meters. For the indoor setting, the maximum distance between the two nodes for the power levels of P0 and P4 was 40 meters and 44 meters respectively. These findings showed that the difference between the two levels of power consumption was minimal. As such, the transmitting power of nodes of the system can be reduced for environments with less obstacles, thus reducing the power consumption of such nodes. Table 2 summarizes the detection coverage range based on two power levels, namely P0 and P4.

In this study, trade-offs among energy, latency, and throughput of previous measurement results were examined to determine whether the proposed system had performed better compared to existing systems in reducing the overall cost of sending a fixed amount of data from the source to the sink based on fixed sampling frequencies. The results showed the number of iterations of the data packets transmitted by the tags also influenced power consumption as it would take a few milliseconds for the tags to receive such packets. Furthermore, for the lowest sampling period, the energy consumption of RFID tags increased with increasing amount of packets [23].

V. CONCLUSION

As demonstrated in this study, the embedded RFID woth intelligent system mesh can be effectively utilized for lng distance. Given that networks based on mesh topology are self-healing and self-organizing, they can be used for a number of applications, such as industrial monitoring, that demand a high level of reliability. Moreover, the process of integrating mobile devices into wireless technology is less complicated compared to that of wired technology. In addition, such technology can help set up a temporary network, in which performance measurements can be quickly carried out to gain better insights into the understanding of the impact of various settings on data transfer and communication, which surely can help improve the performance of such a network.

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