Arowana Breeding System Development Using Internet of Things

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Abstract: - The application of Internet of Things is far and wide, the things of daily life are connected by carrying sensing technology and transferring information through the Internet. In this paper, we develop a system of IoT (Internet of Things) for breeding of Arowana. The idea of Internet of Things will be applied in the breeding of arowana, the key technology contains three main parts. First, we use Arduino Uno R3, and integrate a variety of sensors and automatic devices (for example: water level sensors, temperature sensors, water solenoid valve and the aquarium heater), the system changes all the time to collect the data of water quality, water level, temperature and automatically adjust the water temperature and water level. Secondly, we use Visual C# to develop a windows application, the information obtained by the Arduino aggregated to the database server via Serial port transmission. In addition, we also include OpenCV library, monitor the Arowana moving image through the WebCam and shooting photographs for records during fixed cycle. Thirdly, we set up an IIS server for dynamic web site, and develop an ASP.NET web site with responsive web design, allowing users to various specifications of the smart device. In order to facilitate the download, we also additionally developed a user-friendly Android App. In the present study, we provide adequate information regarding water quality control, water level, water temperature and activities of arowana in their best breeding situation, for the pet fish farming industry as well as aquaculture industry, with a hope that they can maintain a stable environment for breeding fish in a more controllable and comprehensive way.

Key-Words: IoT, Internet of Things, Arowana, Arduino, Open CV, responsive web design

1 Introduction

Internet of Things (IoT) was built with popularity of internet and carriers of traditional telecommunication, connecting each individual physical object endowed with a web address for searching, and forming an internetworking for virtually everything in daily life, in which intercommunication is made possible [1][2][3][4][5].

Like computers and internets, supplies of information for IoT also rely on manpower via voice recording, scanning, and typing. However, people ate limited in time, physical strength, and accuracy. With help of computers, people can acquire information with much less time and strength, noting the time for maintenance and replacement. Potentiality of IoT is far beyond our imagination.

With advent of internet and telecommunication technologies, many related industries are improving with cooperation with ICT industry. Application of IoT for fish breeding is focusing on control of eco aqua system providing best environment for farmed fish. As the saying goes, to breed fish is to breed quality water. And to keep water with quality for breeding fish in constant and stable growth is a considerable learning. The fish are often prone to disease and sudden death due to changes of the environment.

Typically, control of water temperature and other elements properly, can reduce the damage to a minimum. To make Arowana breeding easier and reduce the barriers for the beginners, application of IoT with adequate information can prove to be a new effective method, which has not yet been incorporated into breeding of arowana.

Arowana fish is a famous ornamental fish; different kinds of arowana have different colors; and with increasing age, color scales on the body will turn to be more shiny and thick; if put in improper

environment its body and colors cannot be presented perfectly. In this study it is hoped that integration of IoT technology and breeding method may help enhance the value of the industry.

Arowana breeding is a high risk investment, as it may be prone to disease and death any time because of water quality, water temperature, or tripped electricity. If ICT technologies can be applied to monitor the environment, unfavorable factors for water can be removed without delay and the loss can be reduced to a minimum. Instant on-line detection system has been used with components of various monitoring sensors.

In addition to real-time information, uploading of historical data and ad hoc queries, comparative historical trend data, and the use of large data management and analysis have made it possible to assist the aquaculture industry in establishing monitoring management system, and, more importantly, the real-time information with water tank monitoring, can immediately deal with the strain.

2 Background

In this section, we will introduce arowana breeding and Arduino technology.

2.1 Common species of arowana [6]

2.1.1 Golden arowana

Golden arowana as shown in Fig.1 is the highest price for arowana of the same posture, featuring brightness of golden dragon scales. Besides golden color, other colors of purple, blue and green can also be found. The colors are presented with metal texture, and very stereoscopic. Since golden arowana is highly sensitive and nervous and can easily be stimulated, often due to damaging irritation. Golden arowana mainly come from Malaysia.

Fig. 1 Golden arowana

2.1.2 Red arowana

Red arowana with the main colors orange and red, is the most widely reared arowana fish, grown up with bright color and large body. The common red arowana are mostly chili-red and blood-red. The red pepper arowana are seen with scales of rough frame, dark red gill cover and a large fin in appearance; blood red arowana are seen with scales of thin frame, a long thin body and its eyes and fins are smaller than red pepper arowana.

2.1.3 Green arowana

Green arowana is the most inexpensive arowana fish in the market and the most readily available. This species is not endowed with bright colors. There are two kinds of green arowana: transparent and opaque scales. With strong fecundity the fish is very vigorous, in the place of its origin green arowana often appears more than 80CM in length.

2.1.4 Red-tailed arowana

This kind of arowana has fins and tail in yellow and orange, the back not in golden color, less expensive species, born from mating of the red and green arowana, mainly come from Sumatra Island, Indonesia.

2.1.5 Silver arowana

Commonly known as silver belt, an edible fish at the origin, it can easily grow to 1 meter long. This fish is very easy to breed.

2.1.6 Black arowana

Commonly known as black belt, and the only difference from silver belt is black color on the body, it is somewhat more difficult to breed than silver arowana.

2.2 Breeding environment

Arowana, under normal circumstances, are rarely getting sick. Origins for disease for the fish can be temperature and pH value of the water. To prevent illness for arowana, feeders have to pay attention to changes of temperature and pH of the water. Common diseases for arowana may include gill cover curly, eyes drooping, eyes burst, pine disease, scales and fins defects, corrosion of scale disease and anchor worms.

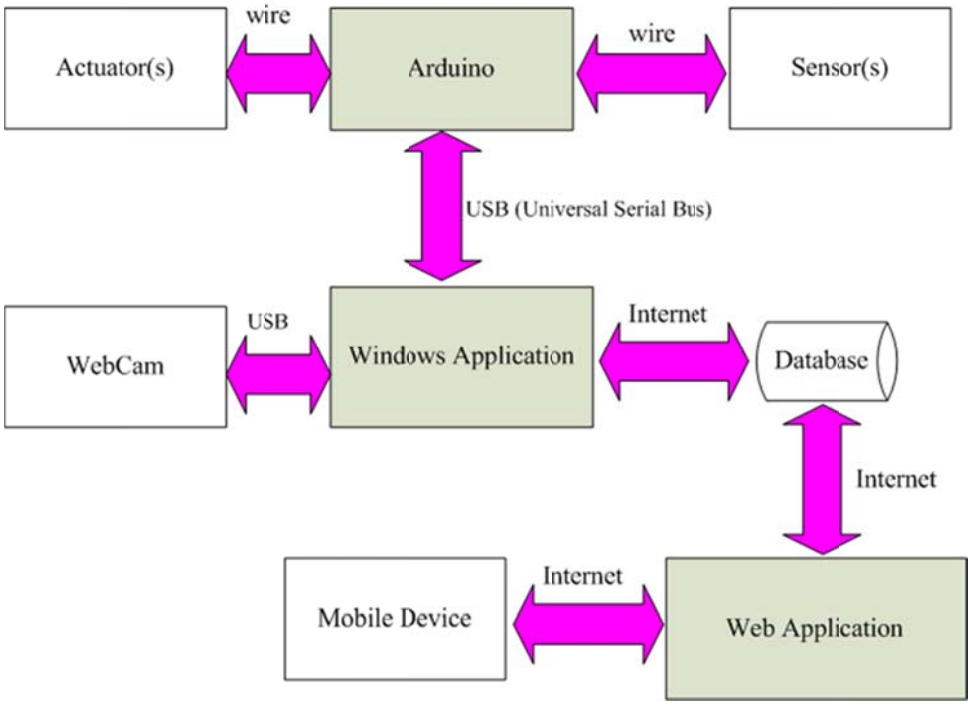

Fig. 2 Framework for study

2.3 Arduino [7][8]

Arduino has been developed with an open-source, based on I/O interface control panel, and has a development environment similar to that of java and C language, allowing users to quickly use Arduino language and software like Flash or Processing to make interactive works. Arduino was designed by Professors David Cuartielles and Massimo Banzi of Milan Interaction Design Institute, in January 2005.

The original idea was to allow designers and artists quickly learn the basics of electronics and sensors through Arduino for rapid design, prototyping works, and integrate with FLASH, MAX/MSP, which were learned from current design school, making interaction between virtual and real much easier.

Interactive content of the design is what the designers really need. As for how to put together a single-chip development board, or how to build a knowledge involving circuit and the like, it is not what the designers need to know, for the same reason, it is not suitable for people with electronics background to design a variety of interactive devices. Among the common Arduino devices are Duemilanov board, Uno board, Leonardo board and so on. In the present study, Arduino Uno R3 is employed.

3 Framework and flow

Sensors for water temperature and water level receive signals and relay the signals to Arduino, as shown in Fig. 2.

Arduino transmitted information via USB Windows application, and it can also determine whether or not to start actuators to add water or temperature. Windows application is written with C# to receive signals of Arduino through the Serial port, and integrate OpenCV library. In three minutes for the cycle, timed capture is attached to the webcam before the tank. Images, photos and information are all written and stored in cloud database. In order to facilitate information stored in the web, this study team developed a dynamic website of ASP.NET, and set up an IIS web server for adding pages. The dynamic web pages also use responsive web design (RWD) technology. Finally, we have packaged the dynamic web page into an Android App for easy download with users of mobile devices which screens are varied in size. Hardware part of this study, as shown in Fig. 3, is connected with four IO pins (Pin2, Pin3, Pin4 and Pin5), in addition to VCC and GND, with features as follows:

PIN2:

The connected water temperature sensor is using a single line control chip DS18B20 digital temperature sensor with a measuring range of -55 ° C ~ + 125 ° C and accuracy of ± 0.5 ° C.PIN2.

PIN3:
Water level sensing module is connected, through ten parallel wires with electrical conductivity to determine the water level, measuring the amount of water level, and the output values can be read directly by the developed Arduino board to detect efficacy of water level.

PIN4:
The connected water solenoid valve originally used for a washing machine can be equipped for a variety of places. When the water level sensing module detects low water level, Arduino will send the signal to the relay module and water solenoid valve activates to start replenishment.

PIN5:
The connected heater: when the temperature is below the set value, Arduino will send signal to the relay module activating the heater for water heating; when the temperature is higher than the set value, the heater stops working in order to achieve equilibrium of temperature.

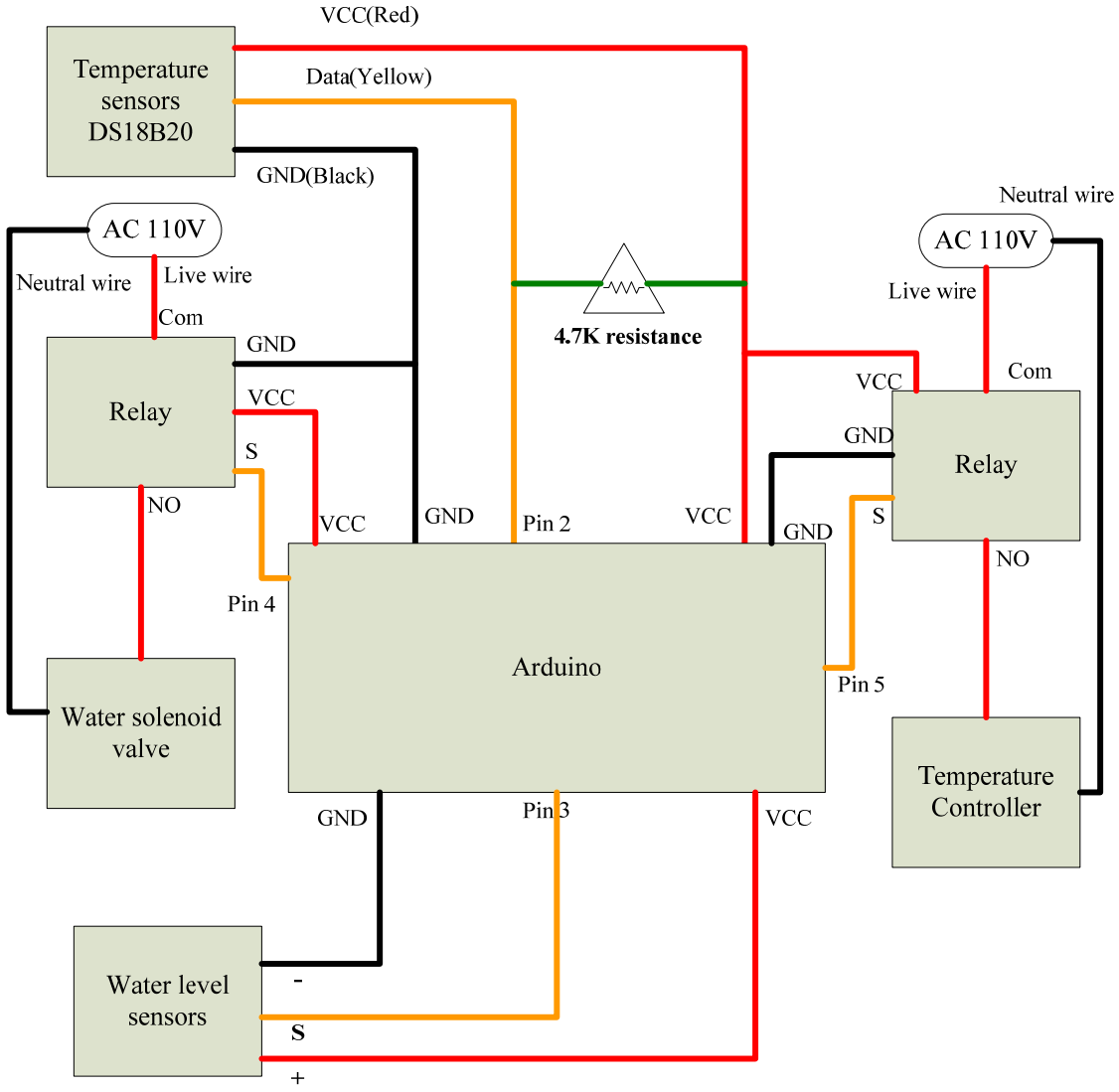

Fig. 3 Hardware wiring diagram

Water solenoid valve and heater relay module as shown in Fig. 4.

Fig. 4 Hardware modules

As shown in Fig. 5, the computer, tablet or mobile device can always monitor the status of water temperature and water level data and activities of arowana.

Fig.5 Screenshot of mobile device

In the image capture of the device as shown in Fig. 6, the system only reads the image with the Webcam, and the system will capture image every three minutes storing in the database for retrieving to read and observe.

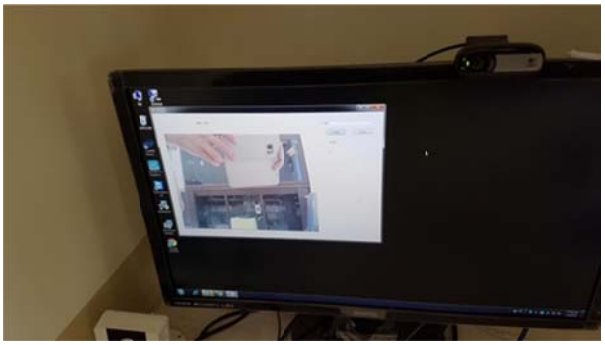

Fig.6 Webcam image

During the experiment, the water level sensors was put into the water for two days, after conducting electricity, water level sensors produced serious corrosion oxidation, as shown in Figure 7.

Fig. 7 Corrosion of sensor for water level

Presumably, due to corrosion caused by oxidation of the aquarium environment, we, thus, tried to improve the water level sensor. We retained one-third of the PC board, and connected it with stainless wire so as to prevent rusting and extend depth of detection. During the experiment, we found that if two stainless wires spacing with 3mm or more, it often failed to detect the correct water level situation, so we connected and fixed 10 wires of the original water level detector and had them secured.

We found that with 2 cm contact of water the correct level can be detected with normal operation of many experiments. Oxidative corrosion was improved. The finished product is shown in Fig 8.

Fig. 8 The improved sensor for water level

Generally, Arduino may use breadboard wiring, which can be easy to loose causing poor contact and not pretty either. In this study we have Arduino, water temperature and water level sensor integrated in a black box for easy storage and access as shown in Fig. 9 and Fig. 10. Then we attach the aquarium with Arduino detection module control box, heating and water control relay module box and water replenishment solenoid valve plug, and our wisdom aquarium is therefore completed. Actual product photo is shown in Fig. 11.

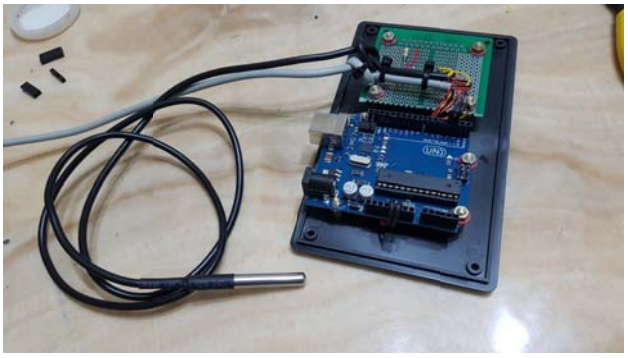

Fig. 9 The inside of the hardware integration

Fig. 10 The appearance of hardware integration

Fig. 11 Wisdom aquarium

4 Conclusion

In this paper, Arduino, water level and water temperature detection modules, webCam, water solenoid valves and other electric equipment are all easy to come by with cheap prices. The industry need not to worry about the price. And, as a good choice, Arduino can easily expand its features.

Popularity of arowana fish with skyrocketing price is due to its feng shui features particularly welcomed by underworld vice industries, as the fish is fierce and aggressive in spirit with a body looks like a machete. Maximum functionality of feng shui fish is for luckiness, prosperity and suppressing evil spirits. The Chinese name for arowana is dragon fish, an auspicious symbol for the people. Breeders are mostly attracted by the color and posture of arowana.

Many people regard arowana as incarnation of the dragon, an auspicious symbol of good luck and prosperity deep rooted in minds of the Chinese people. Therefore, breeders of arowana with such a purpose are better endowed with economic capacity and more peculiar in the environment for breeding arowana with a hope for bringing in more wealth.

Breeding of arowana depends on aquarium with equipment, whereas content of aquarium is the most important factor. Water for red arowana survival needs is in the range of weak acid to neutral with pH value between 6.5 to 7.5, and DH (total hardness) value of 3-12. The water temperature is better maintained at 25 to 28 degrees Celsius, and nitrite and chlorine content is preferably zero. The water level is better maintained at 80% full position in the tank.

These data are established to set up a stable environment for breeding arowana. It is no easy to keep the environment with stability, even for the successful breeders.

This study is intended to use concept of IoT combined with electronic technology, sensors and network communication technology, to achieve water quality monitoring, environmental monitoring, video monitoring, remote control and SMS notification, facilitating the breeders to control status of the aquarium for its optimized benefit simply by handheld devices.

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