Fabricate the Auto-aquaculture Structure with Android Monitoring System

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***Abstract*—Based on the Android monitoring system, the automated fish feeder has been developed. The system provides a convenient and reliable solution for fish farmers. This system includes a fish feeder that distributes food at predetermined intervals. The Android application allows farmers to monitor and control the feeding process remotely. The application displays the current feeding schedule. At the same time, the users can adjust the frequency and amount of food dispensed. The alarm function can send the notification information to the farmer's mobile phone if the feeder experiences any issues or requires maintenance. By automating the feeding process and providing real-time monitoring, the system can help farmers optimize fish growth and health while reducing the time and effort required for artificial feeding.**

Keywords-Automated Fish Feeder; Android; Remote Control; Real-Time Monitoring

I. INTRODUCTION

A. Project context

Automation is defined as self-regulating control of equipment, system or processes without human intervention [1]. Surely, the scientific wizardry of automation suggests that the day will surely come when everything is automated. Some fish breeding center and fish shop the fish and breeding system is manually operated. The owner of some fish breeding center and pet shop hire a person/s to feed the fish twice a week and to monitor the aquarium and the fish [2-3].

In addition, developing an Automated Fish feeder with web-based monitoring system that will greatly assist fish breeders and the productivity of the farm was to help them operate more without bearing too much of a cost on other things [4-5].

The project was also very convenient on the part of the fish breeders when on vacation and for those living a busy lifestyle because some fish are sensitive normally need to be fed once or twice a day [6-7]. Traditional feeding is done manually.

The traditional way to feed fish is by hand feeding and monitoring, the manual monitoring of the fish needs a one or more person to monitor the fish activity and the to monitor the breeder fish [8]. The breeder fish is very sensitive so need to monitor it daily.

The Automated fish feeder with web-based monitoring system is a self-feeding machine that can automatically fed the fish regularly [9-10]. In order to feed automatically the servo motor was control by microcontroller board or the Arduino board [11]. The servo motor is set or program to feed the fish in accurate time [12]. The self-feeding machine has two sensors for monitoring purposes; the first sensor is water temperature sensor the

sensor that was sense the water temperature inside the tank and the output of the water temperature is Fahrenheit. Secondly, the water turbidity sensor, this sensor can sense the turbidity of the water, or the clarity and turbidity of the water in the tank [13]. The two sensors were ease the task of fish breeders for their monitoring for their fish especially for breeder fish that is so very sensitive to the temperature and water turbidity.

The fish farmers and fish pet enthusiast, which are the main target of the development of the project, could significantly benefit an easy access of information inclined to feeding and aquarium monitoring relevant to aquaculture progress in the country [14], it is reasonable to innovate the original process of acquiring feeding and monitoring management knowledge into a new technical perspective.

B. Objective of the project

The primary objective of the project is to develop a prototype that would automatically feed the fish powered by Arduino. This includes having precise processes such as time setting and adjusting feed release. The monitoring on the prototype water condition is to ensure that the fish inside the aquarium is healthy at its right water temperature and turbidity [15].

This prototype is rising to encounter the following objectives specifically:

1) To design an automated fish feeder with based monitoring system.

2) To generate results based on the data provided by the Arduino sensors.

3) To create a web-based monitoring system

4) To test the functionality for the following features:

5) To gather recommendation from the students and respondents.

6) To evaluate problems encountered.

C. Scope and limitation of the Project

The scope covers the lists of capabilities that an Arduino-based fish feeder can perform while limitations are the operations that the device Automation of fish feeding was mainly control by the system which is powered by Arduino and sensors, the servo motor program to release feeds once a day with specific time period. The prototype only focuses on tropical fish such a gold fish, carp, koi, and molies for breeding. Desktop apps focus only on water temperature and turbidity. The prototype is design with feedback sensors which are the Waterproof Temperature Sensor Thermal Probe Wire Thermometer DS18B20 and turbidity sensor to monitor the fish using web-based and desktop application. While feed container is mainly controlled by Servo motors to aid the dispensing of feeds from the container.

The prototype would be capable of releasing feeds at a given time. The output of the prototype was display in the automated fish feeder desktop application and automated fish feeder web-based application. The prototype can only measure temperature ranging from 0-99 degree Celsius and the result of turbidity sensor based (NTU) Nephelometric Turbidity Units. The instrument used for measuring it is called water turbidity sensors, which measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample and the water turbidity sensor can only measure water turbidity ranging 0-900 turbidity units.

II. REVIEW OF RELATED LITERATURE

A. Aquaculture

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

B. Fish feeder system

The fish feeder system is a device or an electronic gadget that has been developed or designed to dispense the exact or right number of pellets at an exact time. However, this particular system has also demonstrated the ability or functionality to accurately repeat the task every day, and is therefore highly efficient and productive in the field of fish farming in the long run. This device fed fish following the right schedule and amount pre-defined by user, therefore avoiding the issue of overfeeding.

Visit the livestock aquaculture in spots, revealed that the entrepreneur hire employee to feed fish in ponds. Through the interviews, most entrepreneur think that feeding fishes by using automatic fish feeding system is more easy, useful and more effective, although it is need a high cost to develop at initial stages. Besides that, many entrepreneur or fish culturists did not know about the existence of the system or machine of fish feeding.

C. Development of Automatic Feeding Machine for Aquaculture Industry

According to the department of process and food engineering, faculty of engineering university pure Malaysia the Aquaculture is a growing industry with a great potential towards the contribution of the country’s total fish requirement. Serious efforts have been done to develop and improve the production of fish by rearing high value fish in tanks or ponds. Under the Third National Agricultural Policy (1998-2010), the target is to annually produce 1.93 million tons of fish worth approximately RM8.3 billion by the year 2010. Consequently, the development of an automatic fish feeding machine can be very beneficial to the growth of the aquaculture industry. This device was developed to overcome labor problems in the industry and introduce a semi-automatic process in the aquaculture industry. It is capable of distributing various forms of dried fish food (such as pellets, sticks, tablets or pellets) to a tank or pond in a controlled manner within a set time period. The automatic fish feeder is controlled by a digital timer and it is capable of feeding the fish in accordance with a pre-determined time schedule without the presence of an operator, and at a feeding rate of 250g/min. The feeder can be adjusted to the desired height and conveniently moved around to be positioned adjacent to the pond or tank. Meanwhile, its hopper can be covered and easily dissembled to change the size of the hopper to accommodate different capacities of feed. This automatic fish feeder can be implemented in aquaculture system to convenience to fish culturists.

D. Development of an automatic fish feeder

The automatic fish feeder was designed, fabricated and tested. It eliminates major problems associated with manual feeding in aquaculture. The machine was powered electrically by one horse power motor. The overall dimension of the machine is 62*45*45cm. The hopper carrying capacity is 5.5kg/volume of hopper with a variable discharging chute. The timer was designed with a 24hour time step at user's specified discharge duration. Test results at the discharge time of 60 minutes showed that 85.5kg of feeds were evenly distributed across the pond. Less than 3% feed loss was recorded due to breakage and fragile nature of feed. The machine has 86.9% efficiency and adequately manages and preserves feed under harsh conditions.

E. Automatic Feeding Control for Dense Aquaculture Fish Tanks

According to the efficient CV system to continuously monitor the fish-eating activity. Detect excess feed, and automatically control the feeding process. A two-class classifier is learned to distinguish whether fish are actively consuming feed or not. To detect the amount of feed floating on the water surface, we propose a novel two-stage approach.

First, a supervised learned correlation filter is applied to the test frame in order to detect every individual feed. Second, a Support Vector Machine (SVM) classifier is deployed as a refinement step of the correlation filter output, which attempts to suppress falsely detected feed while preserving true feed. Furthermore, we propose to detect feed in an optimum local region only, rather than the entire frame whose accuracy

and efficiency are both less than ideal. Using the particle filter technique, the local region is estimated by maximizing the correlation between the number of locally detected feeds and the actual number of feeds in the entire frame. Finally, based on continuous measurements from fish activity and feed detection, various actions take place to control the feeding process.

III. RELATED STUDIES

A. Automatic Fish Feeder System Using Microcontroller

This device developed combines mechanical and electrical system in controlling fish feeding activity as shown in Figure 1. Page 15. The pellets controlled by DC motor which located under the pellet storage. A control system was then attached to this device allowing the fish to be fed at the right cycle time as required or predefined by user or entrepreneur. Timer was employed in this device to control the motor rotation attached to sphere former, which dispense the pellets into the water. The pellets dispensed into the marking area of the pond based solely on the rotation speed of the motor itself. The controller came with a keypad giving user more option in determining the suitable speed for the motor depends on their cattle.

B. Turbidity Units of Measurement

A wide variety of probes are available to measure turbidity the degree to which light is scattered by particles suspended in a liquid. The measured turbidity, however, this depends on the wavelength of the light and the Angle the detector is at. Turbidity detectors don't all use the same light source for a variety of reasons，angles of measurement to detect the scattered light, and signal processing strategies. As a result, measurements from different makes/models of turbidity probes may not be comparable to one other.

Turbidity is measured in NTU: Nephelometric Turbidity Units. The instrument used for measuring it is called nephelometer or turbidimeter, which measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample.

The unit used in the ancient times was JTU (Jackson Turbidity Units), measured with the Jackson candle turbidimeter. This unit is no longer in standard use.

C. The Arvotec Feeding Robot

The Arvotec Feeding robot was developed in order to meet the customer requirement. The Arvotec feeding robot improves the feeding efficiency and saves labor time. One feeding robot supplies many tanks, eliminating the need for a feeder at each tank. A high feed turnover rate through the hopper eliminated rancidity or other 16 storage problems. The Arvo-Tec T Drum feeder has a very high accuracy, whilst remaining at a competitive price. The feeder is multifunctional and is suitable for start feeding in hatcheries to on-growing on tanks, ponds and cages. Feed amounts are automatically calculated separately to each tank according to automatically updated biomass data, incoming water temperature and oxygen content. The system is easy to use with a menu driven display in control unit or an optional MS Windows based PC connection. The feeding program is controlled by a microprocessor mounted on the robot, which can be connected to a PC for monitoring and control by a centrally managed Network Control System. The disadvantages on this robot are it high cost of manufacturing and difficult to operate this robot uses battery power supply 24-volt direct current and speed 16 minutes per meters.

The standard feeding system utilizes one or more feed storage silos, a regenerative or positive displacement blower, one or more frequency-controlled dosing augers, rotary air lock (sluice) hopper, feed injector and a rotary selector valve and diverter valves. The operator interfaces and programs the feeding system with a standard Personal Computer (PC) programmed with our Auto Feeder Software. In basic operation feed from the storage silo empties into a feed dosing auger. The auger moves this feed into a sluice-hopper-injector system. The injector introduces the feed into the main transport pipe. The feed is then picked up by air from the blower and moved into the distribution valve where it is directed into the individual feed pipes travelling to the specific tanks, raceways or net-pens on the site.

All aspects of the feeding operation such as feed rates, meal times, feed types, etc.

D. Aquarium Water Temperature

To make temperature reading easy, consider purchasing an adhesive temperature strip that can be applied to the outside of your aquarium glass. They are inexpensive and available at your local fish retailer. Monitor the sun-Too much sunlight can cause algae growth. If you are installing a new aquarium, place it away from a window. If your existing aquarium is near a window, use a shade to reduce the amount of ambient light. Avoid heat never place an aquarium above or near a heat source or air conditioner. You want to keep the area's temperature as stable as possible. For all species of fish, there is a middle ground in which they are happiest, and they must be kept within that range for optimum health. Examples: Tropical fish 22-26.6° C (optimal is 25.5° C), Common Goldfish 18.5-22.5 ° C, Fancy Tail Goldfish 20-22.5° C. Submersible heaters are the most popular. Some are adjustable and others are pre-set at 78° for your convenience. Be sure to purchase a Pour tank. Never remove a heater from the water if it is still turned on. Unplug it first, let it cool, and then remove it.

E. Feeding Systems for Sea Cages

The AQ300 Adaptive feeding system uses the Infra-Red waste feed sensor and controls automatic feeders and feed cannons on sea cages. The AQ300 is versatile having managed feeding on 18 species of cultured finfish and it also monitors key environmental parameters and transmits data locally or globally through the mobile phone network.

A recent focus for AQ1 was the development of video-based feeding systems. Popular with Tuna and Kingfish farmers the AQTV-Pro connects with one or two single or Pan/Tilt underwater cameras and transmits video images of fish feeding via WLAN to a feed boat/barge or by 3G (internet) to anywhere in the world.

F. Feeding Systems for Pond

Understanding the needs of pond farmers to control feeding accurately, AQ1 has been developing passive acoustics (hydrophone) technology over the last 4 years. The SF500 Sound Feeding System contains smart algorithms which analyses fish feeding sounds and intensity and algorithms to control feed output to match this feeding intensity precisely.

IV. METHODOLOGY

A. Technical Background

Nowadays some of aquaculture has improve their feeding management by using high-tech gadgets or machine for their fish, but still, they sometime need manual survey, which is referring to human job to manage their machine. There are many jobs that require human labor to perform tasks such as cleaning the feeder, refilling pellets, and even repair or maintenance procedures. Thus clearly, the problem here is to invent a low cost and easy maintenance machine that can help them to feed their fish. The feeding device should be simple in construction and operation, reliable in operation, and relatively inexpensive to purchase and operate. This solution also must have good efficiency in the way it operates and serves as a dependable worker.

Some automated fish feeder sold in the market with the high price that the most fish breeders can't afford. And other fish breeders need to hire a person in order to monitor and to feed the fish, with that problem the fish breeders need to invest more money in order to monitor and to feed the fish. The automated fish feeder can be set time to feed the fish just like a commercial automated fish feeder but the different is, the propose project has a monitoring system. The web-based monitoring system will allow fish farmers to see the results of the sensors. The prototype consists of two sensors; first, the Water temperature sensor which is important to the fish breeder because some fish are more sensitive in the water temperature, second, the turbidity sensors which is important too. The turbidity of the water is very vital to some fishes.

The turbidity is the haziness of a fluid causes by large number of individual particles that are generally invisible to the naked eye, similar to smoke in air. Though invisible and odorless, nitrate can have a deadly effect on a tank's

inhabitants, but there are simple and effective methods for keeping it at a tolerable level.

B. Details of the Technology to be used

The technology use in designing the automated fish feeding and monitoring system are:

TABLE I. LIST OF SOFTWARE TO BE USED

List of Software to be used	
Visual Studio	The visual studio 2008 or higher the software to develop the web side and desktop application.
Adobe Photoshop	The Adobe photoshop CC the software to be used by the proponent to design the GUI of the system.
MySQL	The MySQL the database management system that runs as server.
Google Sketch-up	Google sketch-up the software that use by the proponent.
Arduino	The Arduino is an open-source platform

TABLE II. LIST OF HARDWARE TO BE USED

List of Hardware to be used	
Arduino Board	Microcontroller board control all the devices and sensor attach on it.
Servo Motor	Device main function is to dispense certain amount of feeds.
Water Temperature Sensor	This sealed digital temperature probe lets you precisely measure temperatures.
Aquarium	Prototype being installs.

C. Circuit Diagram

A Circuit Diagram for checking the water temperature with Arduino & water resistant DS18B20 or the sensor can detect the water temperature.

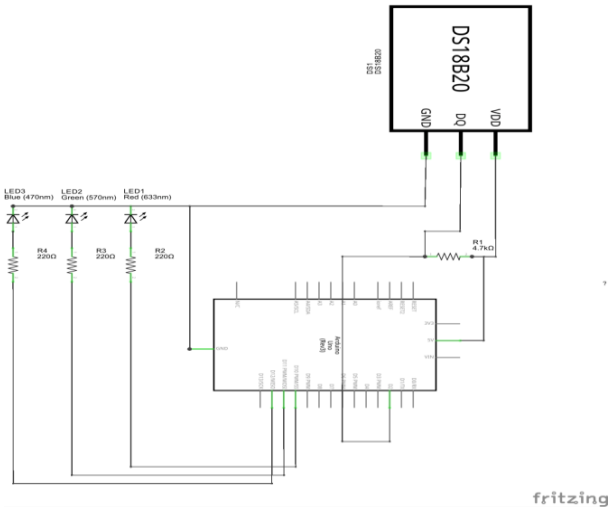


Figure 1. Circuit Diagram Temperature sensor DS18B20

The Circuit diagram for Turbidity temperature this sensor can sense the turbidity of the water. Turbidity is measured in NTU: Nephelometric Turbidity Units.

The instrument used for measuring it is called nephelometer or turbidimeter, which measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample.

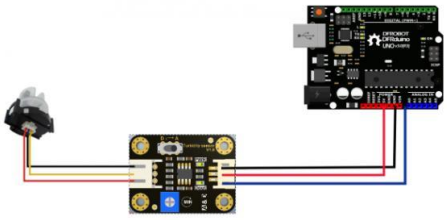


Figure 2. Water turbidity sensor SKU: SEN0189

The highlighted red rectangular shape shows the result of the gathered data from the turbidity sensors.

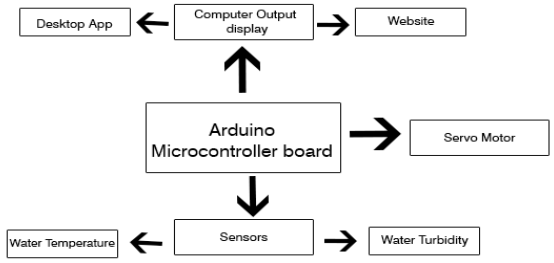


Figure 3. Hardware Block Diagram

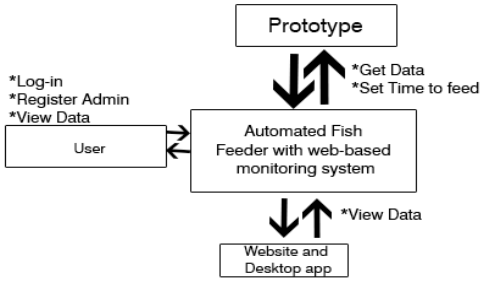


Figure 4. Software block Diagram

D. Capstone Specification

The automated fish feeder and Web based monitoring system is design to be easily learned and adapt by the anticipated users. The users are intended to undergo proper training and orientation in this project. On the other hands, the maintenance and the sustainability of the project will be done by the developer. Generally, the concepts before the users will become an efficient user of the automated fish feeder with Web based monitoring system control application.

The automated fish feeder consists of the following hardware; first the servo motor serves as a feeds dispenser, second the arduino sensors which are the water temperature sensor is to sense the temperature of the water turbidity sensor sense or to detect the water turbidity. The data gathered from sensor will be sent to the Web-site and allowing the fish breeder to monitor their fish through Web.

The proponent develops a monitoring application or web-site that to show the data produce from the sensors.

The user can monitor the Water Temperature and Turbidity in two ways first in offline using the Desktop application and second the web-based monitoring system.

The user can able to see the information of the sensor and the information of the prototype.

The proponent develops a desktop application in able to get data from the prototype and save into the Database.

E. Features of the Desktop Application

Inside this Panel is the System Information, visit website panel, developer info and user manual.

Manage Admin panel this panel can add admin account in able to be login in the desktop application.

Setting panel this panel is the main tool for the desktop application the module to connect or to fetch data from the sensors.

F. Result of the Sensors

Water Temperature

The results of the Water Temperature sensor is automatically sent to the computer. The data gathered from the sensors was stored in the database.

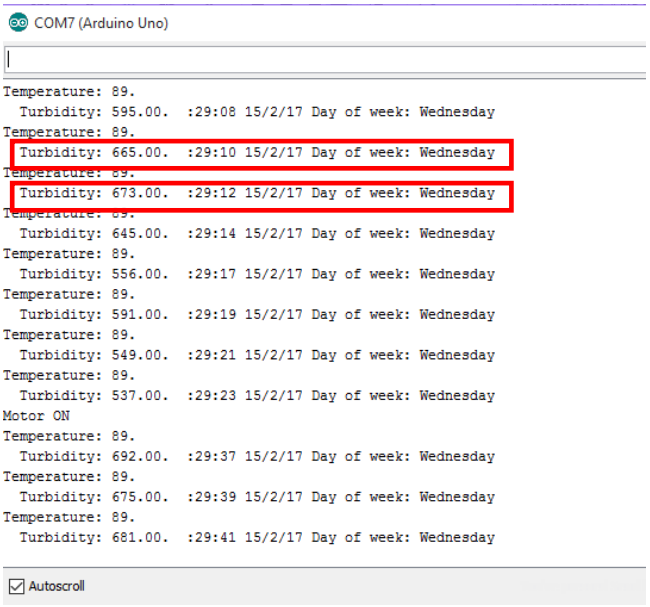


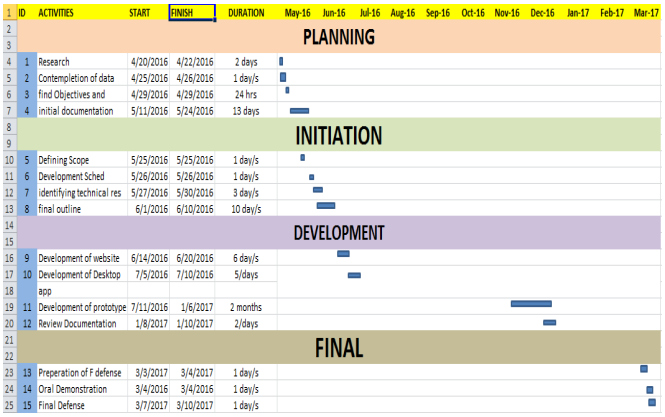
Figure 5. Generated result from the water temperature sensor

G. Schedule Feasibility

The automated fish feeder and Web based monitoring system was appropriate and practical to its time frame in creating the documents, fabrication of the prototype and the development of application.

The list of task with its corresponding duration in Gantt Chart/Schedule of activities in below must be followed to achieve specific goals in exact schedules.

Gantt Chart



	ID	ACTIVITIES	START	FINISH	DURATION
		PLANNING			
	1	Research	4/20/2016	4/22/2016	2 days
	2	Contemplation of data	4/25/2016	4/26/2016	1 day/s
	3	find Objectives and	4/29/2016	4/29/2016	24 hrs
	4	initial documentation	5/11/2016	5/24/2016	13 days
		INITIATION			
	5	Defining Scope	5/25/2016	5/25/2016	1 day/s
	6	Development Sched	5/26/2016	5/26/2016	1 day/s
	7	identifying technical res	5/27/2016	5/30/2016	3 day/s
	8	final outline	6/1/2016	6/10/2016	10 day/s
		DEVELOPMENT			
	9	Development of website	6/14/2016	6/20/2016	6 day/s
	10	Development of Desktop	7/5/2016	7/10/2016	5/days
		app			
	11	Development of prototype	7/11/2016	1/6/2017	2 months
	12	Review Documentation	1/8/2017	1/10/2017	2/days
		FINAL			
	13	Preperation of F defense	3/3/2017	3/4/2017	1 day/s
	14	Oral Demonstration	3/4/2016	3/4/2016	1 day/s
	15	Final Defense	3/7/2017	3/10/2017	1 day/s

Figure 6. Gantt chart for the project timeline

V. Design and Interface

A. Output and user interface design

The figure in the next page shows the sample data from the water temperature and turbidity sensors.

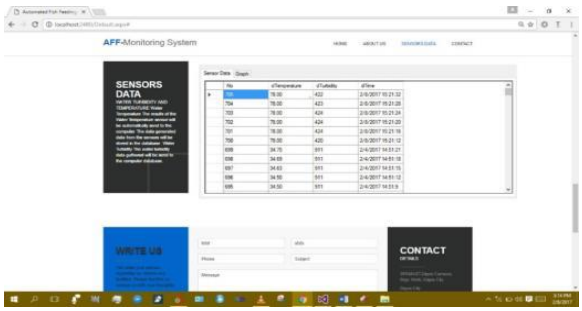


Figure 7. Water temperature and Turbidity Panel.

B. Sample Gathering of data

The table below shows the sample data between Arduino sensors and the manual process.

C. Configuration and Testing Description

First the use clicks the button monitor now to monitor the prototype activity. Then, the login form will pop-op for security purpose. Only admin or the user can use the desktop application. The Sensors Data Tab will view the Data Gathered from the sensors. The User or the Admin can add, edit, delete in Manage Admin Module.

VI. Conclusion

In this paper, an automatic water feeding device is developed with Android system. The system provides a convenient and reliable solution for aquatic farmers. Feed time is set by timer and food is distributed at predetermined intervals. It provides users with remote monitoring and alarm functions, which not only allows users to control the frequency and amount of feeding in the water in real time, but also allows the system to send information to the user's mobile phone when there is a problem. In the normal use of the process of automatic feeding, the system can help farmers to optimize the growth and health of fish, while greatly reducing labor costs. It can provide technical support for intelligent aquaculture.

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References

[1] Myung-Jae Lee, Holger Rücker, Woo-Young Choi, Effects of Guard-Ring Structures on the Performance of Silicon Avalanche Photodetectors Fabricated With Standard CMOS Technology, IEEE Electron Device Letters, Vol. 33, Issue.1, 2012, pp.80-82.doi:10.1109/LED.2011.2172390.

[2] Chee Hing Tan, Shiyu Xie, Jingjing Xie, Low Noise Avalanche Photodiodes Incorporating a 40 nm AlAsSb Avalanche Region, IEEE Journal Of Quantum Electronics, Vol. 48, Issue. 1, 2012, pp. 36-41. doi:10.1109/JQE.2011.2176105.

[3] Kang Yu-zhuo, Mao Lu-hong, Xiao Xin-dong, Xie Sheng, Zhang Shi-lin, Design and simulation of a novel CMOS superimposed Photodetector, Optoelectronics Letters, Vol. 8, Issue.4, 2012, pp. 02549-0252. doi:10.1007/s11801-012-1150-z.

[4] Da Silva, M. F.; Fraytag, J.; Schlittler, M. E.; Marchesan, T. B.; Dalla Costa, M. A.; Marcos Alonso, J.; do Prado, R. N., Analysis and Design of a Single-Stage High-Power-Factor Dimmable Electronic Ballast for Electrodeless Fluorescent Lamp. IEEE T Ind Electron 2013, 60 (8), 3081-3091. doi:10.1109/TIE.2012.2203774.

[5] Fayomi, C.J.B., Wirth, G.I., Achigui, H.F., & Matsuzawa, A. (2010). Sub 1V CMOS Bandgap reference design techniques: a survey. Analog Integrated Circuits and Signal Process, 62,141-157. doi:10.1007/s10470-009-9352-4.

[6] Jong Tae, H.; Moon Sang, J.; Dae Ho, K.; Jun Hong, L.; Min Ho, J.; Jong Ha, S., Off-the-Line Primary Side Regulation LED Lamp Driver with Single-Stage PFC and TRIAC Dimming Using LED Forward Voltage and Duty Variation Tracking Control. Solid-State Circuits, IEEE Journal of 2012, 47 (12), 3081-3094. doi:10.1109/ISSCC.2012.6177014.

[7] JUN Luo, Qian Wang, Xianghai Xiao. A modified artificial bee colony algorithm based on converge-onlookers approach for global optimization

[J]. Applied mathematics and computation, 2013, 219(20):10253-10262. doi:10.1016/j.amc.2013.04.001.

[8] Lixia Han, Shujuan Jiang, Shaojiang Lan. Novel electromagnetism-like mechanism method for multiobjective optimization problems [J]. Journal of Systems Engineering and Electronics, 2015,26(1):182-189. doi: 10.1109/JSEE.2015.00023.

[9] FAN Chao-dong, OUYANG Hong-lin, ZHANG Ying-jie, etc. Optimization algorithm based on kinetic-molecular theory [J]. Journal of Central South University, 2013,20(12:3504-3512. doi:10.1007/s11771-013-1875-2.

[10] Li Y, Liu T, Hu J, et al. Topical Co-Attention Networks for hashtag recommendation on microblogs[J]. Neurocomputing, 2019, 331: 356-365. doi:10.1016/j.neucom.2018.11.057.

[11] Shin Y , Lee S J , Park J . Composition pattern-oriented tag extraction from short documents using a structural learning method[J]. Knowledge and Information Systems, 2014, 38(2):447-468. doi:10.1007/s10115-012-0594-6.

[12] Xiaobing X , Gang Z , Yongzhong H , et al. Dynamic evolution of collective emotions in social networks: a case study of Sina weibo[J]. Science China, 2013(07):150-167. doi: 10.1007/s11432-013-4892-8.

[13] Goonetilleke O , Sellis T K , Zhang X , et al. Twitter analytics: a big data management perspective.[J]. ACM sigkdd explorations newsletter, 2014, 16(1):11-20. doi:10.1007/s11704-013-3903-7.

[14] Das, P.; Pahlevaninezhad, M.; Drobnik, J.; Moschopoulos, G.; Jain, P. K., A Nonlinear Controller Based on a Discrete Energy Function for an AC/DC Boost PFC Converter. IEEE T Power Electr 2013, 28 (12), 5458-5476. doi:10.1109/TPEL.2012.2232681.

[15] Da Silva, M. F.; Fraytag, J.; Schlittler, M. E.; Marchesan, T. B.; Dalla Costa, M. A.; Marcos Alonso, J.; do Prado, R. N., Analysis and Design of a Single-Stage High-Power-Factor Dimmable Electronic Ballast for Electrodeless Fluorescent Lamp. IEEE T Ind Electron 2013, 60 (8), 3081-3091. doi:10.1109/TIE.2012.2203774.