

AUTOMATIC MAINTENANCE SYSTEM USING WIRELESS SENSOR NODE FOR PRODUCTIVE AQUACULTURE

A Project Report Phase - II

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Electronics and Communication Engineering

By

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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APRIL - 2023



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **RISHAV VARMA.R (39130375)** and **PRAVEEN.V (39130356)** who carried out the project entitled "**AUTOMATIC MAINTENANCE SYSTEM USING WIRELESS SENSOR NODE FOR PRODUCTIVE AQUACULTURE**" under our supervision from November 2022 to April 2023.

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We **RISHAV VARMA.R (39130375)** and **PRAVEEN.V (39130356)** hereby declare that the Project Report entitled “**AUTOMATIC MAINTENANCE SYSTEM USING WIRELESS SENSOR NODE FOR PRODUCTIVE AQUACULTURE**” done by us under the guidance of **Dr. G. JEGAN M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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ABSTRACT

Now a day's IOT and Sensor is playing an important role in society as well as any upcoming device. Today's the world most concerned problem is pure water and aquatic living organism. Here on one hand we have shortage of water and on other hands we as humans imputing the water with industrial waste, sewage waste and most of the garbage dumping is done in the sea or some other types of water bodies, which is throwing back to us by making the water to become toxic and full of ammonia nitrate which is extremely harmful for humans as well as all the living things in in water like mammals, fish, plants, and some kind of medicinal weeds that can only founded in the deep sea or oceans. This project is about an system or an Automatic Response System to maintain the toxic level or harmful level of water used for Aquaculture with the help of different types of sensor (i.e. Ammonia Nitrate sensor, temperature sensor, Feeder and oxygen pump) by using them and collecting information through a wireless mess network we are going to take precaution or solve the problem using automatic system once we get the data on water and what kind of harmfulness it contains that will affect the growth of productive aquaculture which is indirectly connected to humans health. Aquaculture is the most affected one here by farming fish and aquatic living in water without any knowledge of water condition on daily bases can causes issues in near future for them. Feeding the fishes while being away could be an difficult task. While this system could be useful for all the things in one check Automatic Maintenance System using Wireless Sensor Node for Productive Aquaculture.

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CHAPTER 1

INTRODUCTION

As a in near future the world will face the cries over water and food which we cannot provide if nature will destroy it so as a preventing measure this system is created in order to keep tracking the water quality. In this project Automatic Maintenance System using Wireless sensor Node for Productive Aquaculture (AMSA) visions to create a not only automatic but portable system which will detect the water bodies, natural behaviors like temperature, humidity, toxic level and aqua organism movement. The vision of AMSA can be fulfilled by the use of different types of sensors in action and wireless node for records and maintenance. So, the improvement of various Information and Communication Technologies (ICT) related to the production of ease little sensors have made it conceivable to screen numerous procedures. Remote sensor systems (WSN) are an unmistakable precedent as they are frequently utilized for cultivating purposes. WSN have been utilized for checking the three forces, nurseries and citrus crops.

In addition, WSN are utilized to screen the condition of homestead creatures, for example, goats or dairy animals. A few frameworks have been proposed for observing fish ranches. They will be break down separately in the related work segment. Most of them depend on observing water quality including only two or three water parameters to be checked. In addition, they for the most part utilize business tests. The business tests for submerged checking have a staggering expense. Along these lines, if a WSN were to be used to screen a few parameters utilizing business tests in all the generation tanks, the expense of the framework would be exorbitant for the fish ranches. Also, different creators propose frameworks for observing fish conduct. In the related work segment, we will examine every proposition.

Internet of Things (IOT) can be described as a connection or a network between physical object like embedded system and wireless things like sensor, software and other technologies through which we can transfer and receive data, information and can also controls other things which has an access through internet. IOT devices can access from simple household electronics to the sophisticated industrial tools. The IOT can handle complex and complicated devices if the purpose of the devices is clear. The IOT devices has become more famous and showed increase in growth on industry field where more work is needed to be done within the time limit, now by using the IOT, humans can work efficiently and more speedily. IOT can be also used as Low-cost computers, the cloud, big data, analytics, and mobile technologies enable the sharing and collection of data by physical objects with a minimum of human intervention. Digital systems can record, monitor, and modify every interaction between connected entities in today's hyper connected environment. The physical and digital worlds collide, but they work together. The use of IOT technology in industrial settings is particularly regarding instrumenting and managing sensors and gadgets that use cloud-based technologies. See this Titan use case PDF for a solid illustration of the IIOT. Machine-to-machine (M2M) communication has recently been employed in industry to enable wireless automation and control. However, as cloud computing and related technologies (such analytics and machine learning) gain popularity, industries may now attain a new level of automation, which in turn enables the development of new income streams and business models. The fourth wave of the industrial revolution is often known as Industry 4.0.

Industry4.0. Businesses are using IOT's enormous business value as it becomes more commonplace in the market. There are some advantages of IOT:

- (1) Gaining data-driven insights from IOT data to improve business management
- (2) Increasing business operations' productivity and efficiency
- (3) Developing new business concepts and sources of income
- (4) Connecting the real and digital worlds of business quickly and seamlessly to

accelerate time to value IOT Intelligent Applications are prebuilt S-AA-S applications that can analyze and display IOT sensor data to corporate users via dashboards. A whole range of IOT Intelligent Applications are available. IOT apps analyze vast volumes of linked sensor data in the cloud using machine learning algorithms. You may see important performance indicators, statistics for the mean time between failures, and other data using real-time IOT dashboards and alerts. Algorithms built on machine learning can detect abnormalities in equipment, inform users, and even start automated repairs or preventative steps. Business users may immediately improve current operations for supply chains, customer service, human resources, and financial services with cloud-based IOT apps. There is no requirement to rebuild all corporate operations.

A wide range of applications are being driven by IOT's capacity to both enable and deliver sensor data as well as device-to-device communication. The most well-known Programmers and their functions are listed below. To ensure that machines are operating within the necessary tolerances, they can be continuously evaluated and monitored. Real-time product monitoring is another option for finding and fixing quality issues. Businesses can rapidly locate assets thanks to tracking. They can ensure that high-value assets are safeguarded against theft and removal by using ring-fencing. IOT is wearable's allow patients to be remotely monitored by doctors and help consumers understand their own health better. Additionally, with the help of this technology, businesses can monitor the health and safety of their employees, which is especially helpful for those who work in hazardous conditions. One illustration of this is the use of IOT to improve linked logistics for fleet management in terms of efficiency and safety. Businesses may enhance productivity by directing trucks in real-time using IOT fleet monitoring.



Fig 1.1: IOT Development Kit

The use of IOT devices for linked assets to monitor the health of distant machinery and initiate service calls for preventive maintenance is an illustration of this. Remote machine monitoring is also enabling new business models that charge clients for the use of a product rather than requiring them to purchase it. The businesses that would profit from utilizing sensor devices in their operational procedures are the ones that would gain from IOT the most. By integrating production-line monitoring to enable preventive repair on equipment when sensors indicate an impending malfunction, manufacturers can obtain a competitive advantage. In fact, sensors can detect when industrial output is being disrupted. Manufacturer can immediately verify equipment for correctness or take it out of production while it is being repaired with the use of sensor warnings. This enables businesses to lower operational expenses, increase uptime, and enhance asset performance management. The deployment of IOT applications has the potential to provide the automobile industry with major benefits. In addition to the advantages of using IOT on production lines, sensors may spot upcoming equipment failure in operating cars and can send out alerts. This drives with information and suggestion. IOT-based apps' pooled data has allowed automotive suppliers and manufacturers to understand more about how to keep vehicles running and car owners informed.

Different IOT applications have positive effects on logistics and transportation networks. Thanks to IOT sensor data, fleets of cars, trucks, ships, and trains that transport inventory can be rerouted based on the weather, the availability of available vehicles, or the availability of drivers. Additionally, sensors for temperature monitoring and track-and-trace might be built within the inventory itself. IOT monitoring systems that give alerts when temperature increase or decrease to a level that threatens the product would be extremely helpful to the food and beverage, floral, and pharmaceutical industries, which frequently carry inventory that is temperature sensitive.

IOT has effectively demonstrated its enormous measure of uses areas in the most recent years. Notwithstanding, little are the fish cultivates today outfitted with clever gadgets with real-time and associated water observing abilities. There are numerous precedents where IOT could assist aqua culturists with improving their working conditions. For instance, some fish ranches are far from the land and utilizing IOT to screen water at a separation could decrease their expenses. Another model is that adjustments in water quality can happen in all respects rapidly and whenever, so observing water continuously with cautions cannot miss a specific occasion. Fisheries and aquaculture bolster the earnings and occupations of 660-820 million individuals, around 10-12 percent of the total populace. The part has an essential task to carry out in sexual orientation fairness, neediness and sustenance security



Fig 1.2: Sensor types

With worldwide fish supply more than 150 million tons, in excess of 85 percent of this supply is utilized straightforwardly for sustenance; providing 15 percent of the world's protein and fundamental nourishment for around 4.3 billion customers.

Aquaculture is likewise presented to immediate and circuitous effects of climatic change, albeit less highlights and outcomes of environmental change influence this segment because of a more prominent dimension of human control. The helplessness of aquaculture-based networks is basically a component of their presentation to extraordinary climate occasions, just as the effect of environmental change on the normal assets required to embrace aquaculture. Anyway changes in precipitation will cause a range of changes in water accessibility going from dry spells to floods and which will decrease water quality. Salinization of groundwater supplies and the development of saline water further upstream in waterways brought about by rising ocean levels will undermine inland freshwater aquaculture

1.1 ABOUT MAINTENANCE SYSTEM

Now we are here to present, in this project Automatic maintenance system this system consists of many types of sensors used in our daily life. The Internet of Things has been adopted to improve productivity and efficiency in agriculture. Aquaculture farming is an important, fast-growing sector of agriculture that has seen the application of advanced technologies. In aquaculture fish, other water bodies, the management of water quality and particularly dissolved oxygen (DO), is critically important for big water bodies like reservoirs. DO depletion is a leading cause of aquaculture mortality in water. Catastrophic loss can occur within hours if ponds are not appropriately managed. The current management practice on pond-based farms is the use of human operators who drive trucks or other all-terrain vehicles throughout the day, but especially at night, to sample and monitor DO in each pond. The associated labor and equipment costs limit the scope and frequency of such sampling since dozens of ponds must be managed by each

sensor-equipped truck. This automatic system requires more and more time to build. We mean automatic and it is exactly what we mean it is fully automatic. It has the feature to sense the harmful substance from the data collected from the cloud system, once the data is collected the system will run test and examine the result uploaded in the server and then detect the harmful substance in the reservoir to detect.

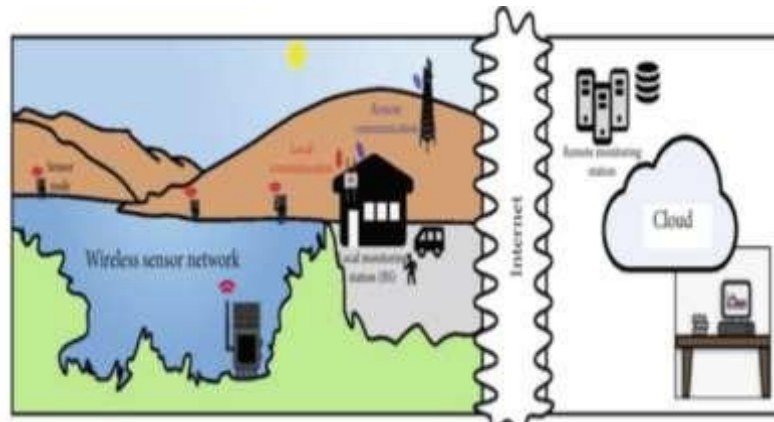


Fig 1.3: Maintenance system

Once confirming the that the water bodies is present with harmful and toxic substance it will raise the alert notification to the owner to in the control center system so that we notice the error, after raising the alert then the microcontroller will send the command to the sensor or to the system to take the needed action in order to prevent and close the harmful substance in water bodies.

1.2 ABOUT WIRELESS SENSOR NODE

Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure-less, wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analyzed. A sink or base station acts like an interface between users and the network. One can retrieve required information from the network by injecting queries and gathering results from the sink. Typically a wireless sensor network contains hundreds of thousands of sensor nodes. The

sensor nodes can communicate among themselves using radio signals. A wireless sensor node is equipped with sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are inherently resource constrained: they have limited processing speed, storage capacity, and communication bandwidth.

After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them. Then the onboard sensors start collecting information of interest. Wireless sensor devices also respond to queries sent from a “control site” to perform specific instructions or provide sensing samples. The working mode of the sensor nodes may be either continuous or event driven. Global Positioning System (GPS) and local positioning algorithms can be used to obtain location and positioning information. Wireless sensor devices can be equipped with actuators to “act” upon certain conditions. These networks are sometimes more specifically referred as Wireless Sensor and Actuator Networks as described in Wireless sensor networks (WSNs) enable new applications and require non-conventional paradigms for protocol design due to several constraints. Owing to the requirement for low device complexity together with low energy consumption (i.e. long network lifetime), a proper balance between communication and signal/data processing capabilities must be found. This motivates a huge effort in research activities, standardization process, and industrial investments on this field since the last decade. At present time, most of the research on WSNs has concentrated on the design of energy- and computationally efficient algorithms and protocols, and the application domain has been restricted to simple data-oriented monitoring and reporting applications).

The authors propose a Cable Mode Transition (CMT) algorithm, which determines the minimal number of active sensors to maintain K-coverage of a terrain as well as K-connectivity of the network. Specifically, it allocates periods of inactivity for cable sensors without affecting the coverage and connectivity

requirements of the network based only on local information. A delay-aware data collection network structure for wireless sensor networks is proposed. The objective of the proposed network structure is to minimize delays in the data collection processes of wireless sensor networks which extends the lifetime of the network. The authors have considered relay nodes to mitigate the network geometric deficiencies and used Particle Swarm Optimization (PSO) based algorithms to locate the optimal sink location with respect to those relay nodes to overcome the lifetime challenge. Energy efficient communication has also been addressed in this the authors proposed a geometrical solution for locating the optimum sink placement for maximizing the network lifetime. Most of the time, the research on wireless sensor networks have considered homogeneous sensor nodes. But nowadays researchers have focused on heterogeneous sensor networks where the sensor nodes are unlike to each other in terms of their energy. The authors addresses, the problem of deploying relay nodes to provide fault tolerance with higher network connectivity in heterogeneous wireless sensor networks, where sensor nodes possess different transmission radii. New network architectures with heterogeneous devices and the recent advancement in this technology eliminate the current limitations and expand the spectrum of possible applications for WSNs considerably and all these are changing very rapidly.

1.3 APPLICATION OF WIRELESS SENSOR IN PRODUCTIVE AQUACULTURE

Wireless sensor network is a kind of wireless network without infrastructure. It integrates the sensor technology, the embedded computing technology, the modern network technology, the wireless communication technology and the distributed intelligent information processing technology. The system can work under a state of long-term unattended. It can detect, perceive and gather the information of the monitoring or environmental objects within the network distribution region in real-time. It receives and sends messages through wireless and self-organization multi-hop routing. Merging the logical information world and the real physical world together will change the interaction way between

people and nature. The technology has good prospects in many areas.

Wireless sensor networks will be able to play a significant role in environmental monitoring, precision agriculture, section irrigation and livestock breeding.

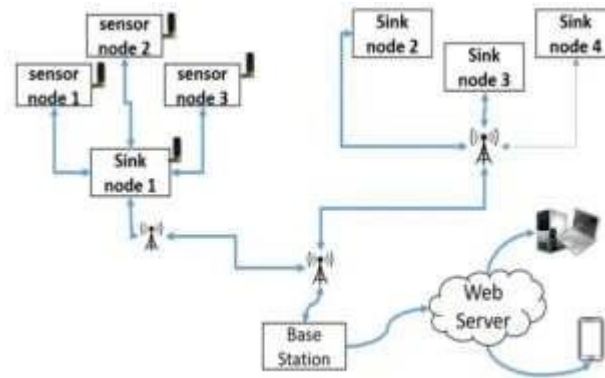


Fig 1.4: Application of wireless nodes

This study is using the wireless sensor network technology to build an intelligent, network-based wireless monitoring system for aquaculture environment. The technology can be quickly applied to the field of aquaculture environmental monitoring, and promote the research and application of the wireless sensor networks technology. To improve the current traditional farming methods and aquaculture environmental monitoring instruments in the field of aquaculture in China. In this paper, we propose a set of practical hardware architecture design for the application of aquaculture.



Fig 1.5: Types of water bodies

The Internet of Things (IOT) and Industrial IOT (IIOT) are exploding, and at their core lies wireless technology, which is made possible by RF, or radio frequency. Devices can communicate with one another using this technology even when they are not physically linked. Having its roots in the early 20th century, RF technology is not new. Yet, in order to meet the massive demand for new consumer and commercial uses, it has expanded to incorporate cellular devices and other advancements. The speed and bandwidth of the underlying networks, the longer battery life of IOT devices, the wider capabilities of wireless communication protocols, and the more secure administration of devices and networks are all technological advancements that underpin this phenomenal development. These developments have made it possible for several businesses to replace costly, complex Wireless communication is frequently unstable compared to cable connection.



Fig 1.6: Solar panel of powering up the battery

So, As for running all this system as one we have to give a massive power backup and power supply. But for every use we have to change the battery, so for overcome the issues the system is equipped with solar charging panel which will give enough power up for the

CHAPTER 2

LITERATURE SURVEY

As we know there are as many systems created to take measure against this problem, still the problem is the sustainability and powerless cost. As sensor are taking over the daily base life, we can quit frequently use this in the project system to reduce the cost and power supply. As this project AMSA system is portable to carry and the result this system node connected to mess network through which we can act it together to get the result and the output values on our system or personal device in real time, there are as many as system is founded or created for the purpose serving to find the quality of water at its best.as given below are some of those survey which leads us to take a innovative step forward in the processing of crating the ASMA system

2.1 LITERATURE REVIEW

Initial Development of the Hybrid Aerial Underwater Robotic System, this article was published by Bing Ouyang, Member, IEEE, Paul S. Wills, Yufei Tang, Jason O. Hallstrom, Tsung-Chow Su, Kamesh Namuduri, Srijita Mukherjee, Jose Ignacio Rodriguez-Labra, Yanjun Li and Casey J. Den Ouden in 2021.

This stated that Aquaculture, especially fish farming, plays a vital role in ensuring food security in the United States and worldwide. However, for fish farming to be sustainable and economically viable, drastic improvements to current labor-intensive and resource-inefficient operations are required. The Hybrid Aerial/Underwater Robotic System (HAUCS) aims to bring fundamental innovations to how pond-based farms operate. HAUCS is an end-to-end framework that consists of three principal subsystems: a team of collaborative aero-amphibious robotic sensing platforms integrated with water quality sensors; a land-based home station that can provide automated charging and sensor cleaning; and a backend processing center that includes a machine-learning-

based water quality prediction model and farm control center. HAUCS will be capable of collaborative monitoring and decision-making on farms of varying scales. The HAUCS platform, payload, and prediction model are discussed.

Design and Development of IOT Based Smart Aquaculture System in a Cloud Environment this article was published by S. Balakrishnan, S. Sheeba Rani, K. C. Ramya, Professor, Department of Computer Science and Engineering in the year 2019.

It stated that Aquaculture is one of the crucial elements to help the nourishment needs of the world network, particularly in creating nations. Internet of Things (IOT) is a hot research subject, as showed by the expanding consideration and the extensive overall speculations dedicated to it. The observing of cultivating procedures can upgrade the utilization of assets and improve its supportability and productivity. It very well may be executed under various conditions. A few offices are sent in the ocean, while different offices are set inland. In inland offices, fish are kept in tanks that can change in size and materials. In offices that perform serious aquaculture, numerous endeavors are taken to augment the execution of the fish. In this paper, we propose a framework for developing an exceptionally beneficial aquaculture framework, equipped for preparing the employments of observing, wise control of the Internet of thing (IOT), irregularity mindfulness, and carbon outflow decrease just as vitality protection. And also includes water quality check, environmental monitoring, power monitoring, and web surveillance platform.

IOT based Automatic Fish Pond control System this article was published by Fariza Halidatsani Azhra, Chaerul Anam, they are electrical engineering from Islamic university of Indonesia, Yogyakarta, Indonesia.

This article was published in year 2020. Aquaculture is a potential sector to be developed by the people of Indonesia considering that Indonesia territory is

dominated by the sea. Based on data released by the Directorate General of aquaculture in 2015, the level of fish consumption projected increase up to 54.49 kg/capita/year. One important factor influencing the success of aquaculture is water quality some physical parameters to describe water quality include temperature, degree of acidity, dissolved oxygen and turbidity. The cause of the death of thousands of fish and aquatic animal is due to carbon emission to hot temperature reaching 36 degree Celsius in November of 2015 is one proof that monitoring and control of pond water and reservoirs is important.

The Preliminary Design of Water Quality Monitor System for the Ecological Pond based on LoRa WANC. -W. Hsieh, Y. J. Tsai, C. Stefanie, C. C. N. Wang and W. -T. S. Chang, "The Preliminary Design of Water Quality Monitor System for the Ecological Pond based on LoRa WAN," 2020 International Symposium on Computer, Consumer and Control (IS3C), 2020.

In the modern aquaculture, diverse environmental sensing in the application of intelligent monitoring system is receiving more and more attention. To monitor the water quality of aquaculture ponds, we design and develop a water quality monitoring system based on LoRa WAN. LPWAN (Low Power Wide Area Network) occupies an important place in IOT communication technology. LoRa (Low Range) is also one of the technologies, with the advantages of long distance and low power consumption which can extend the service life of power supply equipment. In this paper, a system realizes remote collection and data storage of multi-sensor processor information (temperature, pH, conductivity and turbidity levels). The LoRa gateway and Raspberry Pi are implemented to transfer the aquaculture field parameters into the database and presented on the Website. With the remote monitoring screen, users can keep tracking changes of water quality and make timely adjustments without going in and out of the aquaculture site frequently.

A Design of Dissolved Oxygen Monitoring System Based on Nb-IOTL. Yunfeng and Z. Tianpei, "A Design of Dissolved Oxygen Monitoring System

Based on Nb-IOT," 2019 International Conference on Smart Grid and Electrical Automation (ICSGEA), 2019.

Real-time monitoring of oxygen content in fish ponds is of great significance for the intelligent management of fish ponds. This paper proposes a method to realize multi-point real-time monitoring of Dissolved Oxygen content in fish ponds by using Internet of Things technology. The system is mainly composed of three parts: measurement circuit, control circuit and data processing module. The measuring circuit completes the real-time measurement of the Dissolved Oxygen content of the fish pond; the control circuit can complete the oxygen-filling operation according to the set value of the oxygen content; the data processing module can record the historical data in real time and complete the cloud processing of the data and related background operations. After testing, the system can effectively realize real-time monitoring of Dissolved Oxygen content in multi-point fish ponds and control the cost of aerators, thereby effectively reducing losses and increasing production.

A low-cost wireless sensor network for water quality monitoring in natural water bodies. G. S. Menon, M. V. Ramesh and P. Divya, "A low-cost wireless sensor network for water quality monitoring in natural water bodies," 2017 IEEE Global Humanitarian Technology Conference (GHTC), 2017.

Water is one of the precious factors in human life. It plays a vital role in the survival and existence of flora and fauna. But now a days it is been exploited heavily by dumping of human waste, industrial and chemical waste in to the water bodies which is the resultant of water being contaminated with toxic chemicals. Water scarcity and water contamination has been one of the major issues faced by the society around the world. In many developing countries like India, the main focus is given to industrialization and urbanization. But this has caused an increased water usage and water contamination. This paper deals with the monitoring of water quality by mainly considering the physical and chemical

properties of water. For this purpose, a wireless sensor node is designed which will contain several sensors to sense the chemical contents of water. The highlight of sensor node is that it is water proof. The main components of WSN include microcontroller for processing the system, communication system for inter and intra node communication and several sensors. The power for the sensor nodes can be obtained from the solar panels connected to the sensor nodes. Though, in earlier times, there were water quality monitoring systems, they were power hungry and not real time. Apart from acting as a single system, if this system integrates with other innovative solutions like Smart Home or Smart Building, the application of this system would increase leading to an increased demand for it. This paper highlights on how a real time monitoring system can be made generic, using Network Virtualization. Also, new technologies like Internet of Things (IOT) could be incorporated in this system to make it advanced.

Analysis of Water Temperature Stratification and Water Quality Response Mechanism of Daheiting Reservoir in Tangshan City.C. Liu, L. Wang, B. Li, S. Wang and Y. Du, "Analysis of Water Temperature Stratification and Water Quality Response Mechanism of Daheiting Reservoir in Tangshan City," 2018 3rd International Conference on Smart City and Systems Engineering (ICSCSE), 2018.

Debiting Reservoir is located on the main stream of the Luanhe River, 5km north of Qianxi County, Tangshan City. It is an annual regulation reservoir. It is an important drinking water source for the cities of Tianjin and Tangshan. Since the water was passed in 1982, the water environment situation is good. After 2000, with the rapid economic and social development of the reservoir upstream and surrounding areas, especially the cage fish culture in the reservoir area, the water quality of the reservoir area continued to deteriorate. In the spring and summer of each year, the water body in front of the Dam in the Reservoir area showed obvious water temperature stratification and obvious anoxic areas. The occurrence of anoxic zone will have a series of related effects on the water quality

of the water in front of the dam.

Water Quality Monitoring System Based on IOT. M. Sabari, P. Aswinth, T. Karthik and B. Kumar C., "Water Quality Monitoring System Based on IOT," 2020 5th International Conference on Devices, Circuits and Systems (ICDCS), 2020.

According to data issued by human rights commission, 20 million people are still drinking contaminated water in our country. We have to continuously monitor water quality parameters to reduce water related diseases and to avoid water pollution. In preliminary methods of water monitoring, data are collected manually from various sources. This needs ample time and rigorous manual effort. To overcome these problems, we have to adopt new methods for water monitoring. The main aim of this work is to design a system to continuously monitor the water quality parameters based on the concept of IOT. The proposed model employs various sensors to measure the required parameters. With the help of a core controller, the measured parameter values from sensors are processed. Arduino is the core controller used for the entire model. Using a Wi-Fi module, measured data from sensors are viewed on the cloud platform.

Internet of Things (IOT) enabled water monitoring system. T. Perumal, M. N. Sulaiman and C. Y. Leong, "Internet of Things (IOT) enabled water monitoring system," 2015 IEEE 4th Global Conference on Consumer Electronics (GCCE), 2015.

Water is always a crucial part of everyday life. Due to global environmental situation, water management and conservation is vital for human survival. In recent times, there were huge needs of consumer-based humanitarian projects that could be rapidly developed using Internet of Things (IOT) technology. In this paper, we propose an IOT based water monitoring system that measures water level in real-time. Our prototype is based on idea that the level of the water can be very important parameter when it comes to the flood occurrences especially in

disaster prone areas. A water level sensor is used to detect the desired parameter, and if the water level reaches the parameter, the signal will be feed in real time to social network like Twitter. A cloud server was configured as data repository. The measurement of the water levels to be displayed in remote dashboard

The above were the literature of some of the so far system created in for the maintenance purpose, recording the result purpose, securing the life stock like fish and other creatures of the water in large water bodies, mainly used id fish farming and to preventing the pollution of natural water system.

2.2 SUMMARY OF THE SURVEY

By observing the literature of different types of system and implanted process we concluding the survey of the literature over the topic of Automatic Maintenance System using Wireless Sensor Node for Productive Aquaculture

In the modern aquaculture, diverse environmental sensing in the application of intelligent monitoring system is receiving more and more attention. To monitor the water quality of aquaculture ponds, we design and develop a water quality monitoring system. a system realizes remote collection and data storage of multi-sensor processor information (temperature, pH, conductivity and turbidity levels). In Real-time monitoring of oxygen content in fish ponds is of great significance for the intelligent management of fish ponds. Water is one of the precious factors in human life. It plays a vital role in the survival and existence of flora and fauna. it is been exploited heavily by dumping of human waste, industrial and chemical waste in to the water bodies which is the resultant of water being contaminated with toxic chemicals. Water scarcity and water contamination has been one of the major issues faced by the society around the world. In many developing countries like India, the main focus is given to industrialization and urbanization. But this has caused an increased usage and water contamination.

In this project we are discussing that we are using multiple types of sensors like Temperature sensor, pH sensor, oxygen sensor, Total dissolved solid, Air pump, Ammonia nitrogen and Micro controller. The sensors are connected to microcontroller which is connected to GSM module from where our result or examine data records can be transfer and recorded. Now once the target has been examined like if the reservoir has been monitored fully the data will send to the control room or to the receiving end. The data received at this end will be in continuously monitoring system and if the system found any type of harm in the water bodies or at the aquaculture side it will raise the alarm and information will be send to the member and then by activating automatic mode or if the problem is big the team will be dispatch in order to prevent more polluting and they will take the appropriate.

2.3 PROBLEM STATEMENT

First and fore-most problem is cost and time as the water bodies increase in size the time to examine it will increase as the time increase the labor cost and labor management is also increase.

Apart from labor cost the equipment cost is also high. Since many users can afford all the equipment, they don't think of examine their pond or water bodies as a result the livestock like fish gets infected and the large water bodies like reservoirs waters get founs and this cause other aquaculture life issues. There are attempts to reduce labor costs by automating aquaculture pond monitoring, such as the Aquaculture Pond Buoy from In-Situ Inc. Other IOT water quality monitoring solutions include Neer Yantra from PranisCOM and PondGuard from Eruvaka. These and many other solutions employ buoy-based monitoring stations that measure pond-water quality parameters such as DO, temperature, pH, etc. Sensor data can be sent via Wi-Fi or cellular link to a control center for analysis. However, these stationary instruments deployed in the water are difficult to maintain due to bio fouling.

They can be cost-prohibitive since individual stations are required for each site measured in a pond. Stationary instruments suffer from the same limitation as truck-based monitoring. Since only a single location is monitored unless multiple expensive sensor buoys are deployed in each pond. In addition, sensor buoys are an obstruction in the pond during harvest as they must be removed or lifted over the seine. The advantage they offer is a high-frequency sampling. Many proposed solutions do not adequately consider the challenge of data connectivity on farms at various scales.

The Automatic maintenance system using wireless sensor node for productive aquaculture in short (AMSA) framework aims to mitigate the aforementioned issues to provide automated, high-density monitoring of key environmental metrics of each aquaculture pond on a farm using relatively inexpensive robotic sensing platforms.

- The system of automatic maintenance cost more capitals investments.
- The water and area of water bodies like reservoir need to be maintain and kept on check.
- Hazardous and harmful level of water should be check in real time.
- Communication between devise and transfer of real time data is needed.
- Water turbidity and dissolved oxygen should be checked all the time so the aquaculture production and marine live doesn't get affect or any effect.
- Overtime and man power dispatch and then using lab equipment to check the water.

2.4 OBJECTIVE

- To create an environment where aquaculture monitoring is portable and maintenance is easy.
- High Reduction of man power effects of less labor cost.
- Improved scalability (capable of collaborative monitoring and decision-

making on farms of varying scales).

- More accurate reporting of water bodies condition (capable of sampling multiple locations in the pond to monitor spatial and temporal pond variations).
- Mitigated bio fouling (avoiding maintaining sensors in bio-productive water).
- Broad coverage (sensing patterns can be realized to cover a large area).

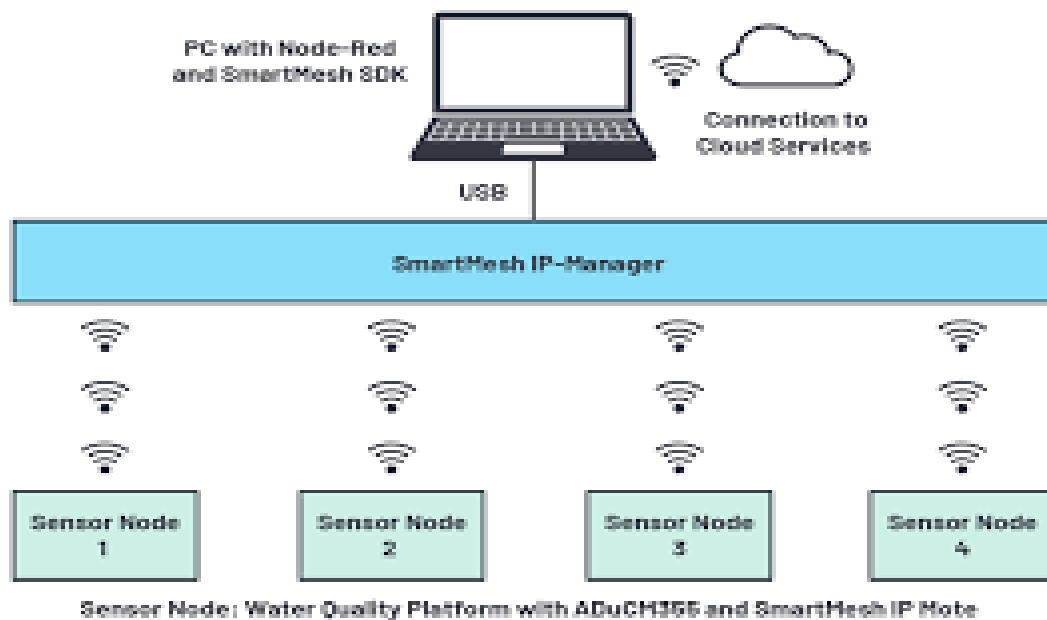


Fig 2.1: Water Condition Monitoring System

CHAPTER 3

EXISTING SYSTEM

(Hybrid Aerial/Underwater Robotic System)

In this chapter 3 we will discuss about the two things the Existing system and this proposed system. That is as we already discuss about this system we show some of the existing system which is used for the same purpose but with different work system. Many industries are trying to reduce the cost of using labor and power.

In this chapter we will show that how This proposed system is different from the existing system. We are mainly working on making it portable and easy to use with less cost.

Hybrid Aerial/Underwater Robotic System (HAUCS)

Aquaculture, especially fish farming, plays a vital role in ensuring food security in the United States and worldwide. However, for fish farming to be sustainable and economically viable, drastic improvements to current labor-intensive and resource-inefficient operations are required. The Hybrid Aerial/Underwater Robotic System (HAUCS) aims to bring fundamental innovations to how pond-based farms operate. HAUCS is an end-to-end framework that consists of three principal subsystems: a team of collaborative aero-amphibious robotic sensing platforms integrated with water quality sensors; a land-based home station that can provide automated charging and sensor cleaning; and a backend processing center that includes a machine-learning-based water quality prediction model and farm control center. HAUCS will be capable of collaborative monitoring and decision-making on farms of varying scales. The HAUCS platform, payload, and prediction model are discussed. The initial deployment of the HAUCS framework at a land-based aquaculture fish farm is presented. Index Terms Internet of Things, robotics, machine learning, aquaculture, coastal zone monitoring, water quality sensors

Precision Agriculture (PA) is the application of robotic field machines and information technology in agriculture, which plays an increasingly important role in farm production. PA related robotic technology has been an active research topic and has seen robust growth. By the United States Department of Agriculture (USDA) estimation, between 1998 and 2013, three key PA technologies saw adoption rates ranging from 25% to 50%: global positioning system (GPS) yield and soil monitors/maps, variable-rate input application technologies, and GPS guidance systems. Many PA applications call for multiple collaborative robots [5, 6], which are closely related to multi-robot persistent coverage problems (MRPCP). The Internet of Things (IOT) has been adopted to improve productivity and efficiency in agriculture [8]. Aquaculture farming is an important, fast-growing sector of agriculture that has seen the application of advanced technologies such as robotics and IOT [9-21]. IOT solutions have been adopted to realize automated feeding on fish farms to reduce waste and avoid water pollution from the excessive feed. In computer-vision based automatic feeder designs [12, 15], videos are streamed via Bluetooth to a control center where the fish feeding behavior is analyzed to determine the degree of hunger, which controls feeder operation. While such a system might be viable for a small-scale fish tank, it would be challenging to scale up to a fish farm with numerous larger ponds (e.g., >2 hectares). To this end, e-Fishery is a more realistic IOT-based fish feeder system. The e-Fishery system is essentially an enhancement demand feeder. One novel design in e-Fishery is that a vibration sensor is adopted to detect fish activity near the river.



Fig 3.1: A basic HAUCS concept of operation

The sensor data is sent back to the control center for analysis to determine the degree of hunger in the pond, which controls the operation of the feeder. Every feeding event initiated by the feeder is recorded automatically to allow the farm to monitor feed expenses. In aquaculture fish farming, the management of water quality, particularly dissolved oxygen (DO), is critically important for successful operation. DO depletion is a leading cause of fish mortality on farms. Catastrophic loss can occur within hours if ponds are not appropriately managed. The current management practice on pond-based farms is the use of human operators who drive trucks or other all-terrain vehicles throughout the day, but especially at night, to sample and monitor DO in each pond (Fig. 1a). The associated labor and equipment costs limit the scope and frequency of such sampling since dozens of ponds must be managed by each sensor-equipped truck. Large farms require multiple drivers and sampling instruments to attain the required monitoring frequency for proper management. The level of resolution that this approach can achieve on any pond is generally restricted to a single near-shore measurement at a point on the pond with a well-maintained roadbed. On large ponds (e.g., 2 to 8 hectares), this may result in a failure to promptly identify localized water quality problems that can ultimately affect a large proportion of the stock. Even though readings should be taken hourly on each pond, very large farms (>400 hectares) with hundreds of ponds, may only be able to take readings at much lower frequencies due to the labor and equipment costs of operating large fleets of monitoring vehicles. Measurements of additional water quality parameters cannot be performed due to the demanding schedules required of drivers to achieve the minimum frequency for DO management. Furthermore, with the current practice, operators have a very limited window of time (e.g., less than an hour in the middle of the night) to react to potential oxygen depletion, increasing the potential likelihood of catastrophic events. The response (e.g., putting emergency aeration equipment in a pond) takes time away from achieving DO measurement frequencies.

There have been attempts to reduce labor costs by automating aquaculture

pond monitoring, such as the Aquaculture Pond Buoy from In-Situ Inc. Other IOT water quality monitoring solutions include Neer Yantra from PranisCOM and PondGuard from Eruvaka. These and many other solutions employ buoy-based monitoring stations that measure pond-water quality parameters such as DO, temperature, pH, etc. Sensor data can be sent via Wi-Fi or cellular link to a control center for analysis. However, these stationary instruments deployed in the water are difficult to maintain due to bio fouling. They can be cost-prohibitive since individual stations are required for each site measured in a pond. Stationary instruments suffer from the same limitation as truck-based monitoring since only a single location is monitored unless multiple expensive sensor buoys are deployed in each pond. In addition, sensor buoys are an obstruction in the pond during harvest as they must be removed or lifted over the seine. The advantage they offer is a high-frequency sampling. Many proposed solutions do not adequately consider the challenge of data connectivity on fish farms at various scales. The Hybrid Aerial/Underwater Robotic System (HAUCS) framework aims to mitigate the aforementioned issues to provide automated, high-density monitoring of key.

	Cost	Speed	Maintenance	All-Weather
Aerial Drone	Low	Fast	Easy	High Wind
Unmanned Surface Vehicle	High (one platform per pond)	Medium	Hard (biofouling)	Good
Stationary Sensors	High (one platform per pond)	Fast	Hard (biofouling)	Good
Human Boom Truck	High (labor and vehicle)	Slow	Easy	Good

Fig 3.2: Comparison of different platform option

With support from the National Institute of Food and Agriculture (NIFA), USDA through the Ubiquitous Collaborative Robots (NRI-2.0) program, the HAUCS project was launched in the Spring of 2019. The development mainly focused on three areas deemed to be of higher priority: the development and deployment of an automated system based on the HAUCS concept on This research partner farm – Logan Hollow Fish Farm, machine learning (ML)-based DO prediction model development, and the HAUCS AUP design. This paper aims

to introduce the HAUCS framework. We also present the initial HAUCS development effort. In Section II, we discuss the overall HAUCS concept. In Section III, we provide some detailed system design considerations.

3.1 THE HAUCS SYSTEM CONCEPT

A. Overview of the HAUCS Framework

HAUCS is a framework that aims to achieve collaborative monitoring and decision-making on aquaculture farms of varying scales. The "collaboration" will be among robotic systems, machines, and human operators. HAUCS consists of the following subsystems: a team of collaborative aero-amphibious robotic sensing platforms capable of in-air and on-water movement, integrated with underwater sensors; land-based infrastructure, such as weather stations and home stations that provide automated charging and sensor cleaning; and backend modeling and processing infrastructure. The backend processing center consists of an ML-based water quality prediction model and a farm control center. A LoRa communication network is employed to connect the different components in HAUCS. The communication hub may also be integrated with land-based components to overcome obstacles, such as tree lines. A Basic HAUCS concept of operations Each HAUCS autonomous unmanned platform (AUP) consists of an unmanned robotic vehicle and submerged underwater sensors. The robotic vehicle will be an aero-amphibious platform that can travel on the water surface and fly in the air. The platform will provide all-weather coverage capabilities important for farm monitoring operations, especially in high-wind conditions. The HAUCS AUPs will cover the entire farm in a reasonable period with high location precision. Data from the lightweight underwater sensors attached to the vehicle, such as DO sensors, will be sent to the farm control center via a radio link during sensing operations. An ML-based data analytics engine will analyze the sensor data to predict pond conditions at the backend.

Sensor data from all the ponds on the farm and the associated weather data will be used to train the prediction model. The model prediction will, in turn,

change the behavior of the HAUCS AUPs (i.e., increasing/decreasing patrolling frequency) or control other instruments to mitigate an emergency situation (e.g., turning on fixed aerator or instructing human operators to move mobile emergency aeration equipment into place in a pond). This highly scalable framework will convert aquaculture farm operations to an "Internet of Aquaculture." The design can be easily scaled up to a multi-farm framework, where a data center gathers sensor data from all the farms for analysis and prediction. The overall concept of operations is illustrated in diagram. The overarching goal of HAUCS is to relieve human operators from the most labor-intensive, time-consuming, and expensive operations in aquaculture farming operations through a group of cooperative robotic sensing and actuator platforms. HAUCS will conduct automated sampling at frequencies relevant for accurate prediction of water quality variation (e.g., hourly diel readings), providing significant advantages in speed, cost, resource efficiency, and adaptability over the traditional manual and truck-mounted water quality measurement systems.

B. HAUCS Autonomous Unmanned Platform

The HAUCS sensing platform will need to meet several challenges. First, the design will need to be power-efficient so that each platform can cover multiple ponds on an hourly basis under all weather conditions. Second, the sensor maintenance will need to be easy since one serious drawback of the state-of-art Aquaculture Pond Buoy is a challenge associated with sensor maintenance. Third, the system will need to be low cost to be acceptable in the aquaculture farm industry. Lastly, the platform will have to maintain a communication link with the control center to send sensor data promptly for accurate monitoring of the overall farm. To meet these challenges, a group of mobile robotic sensing platforms will be employed. The AUP will be integrated with lightweight sensors (i.e., a DO sensor may weigh about 50g). The platform will move through the pond in the air or on the water during sensing operations, dependent on weather conditions, and return to the land base. A payload extension module will be integrated with the platform so that the sensors will be underwater only during the sensing operation.

Another major advantage is biofouling reduction and simplified sensor maintenance. Platform home/maintenance stations will be constructed at several different locations across the farm; each station will be assigned a coverage area (e.g., 100 ponds). The station will host the HAUCS robotic platforms that will monitor these ponds, reducing the traffic on the farm. These platforms will return to their assigned home station, where automatic sensor cleaning can be performed during charging. The home stations will also serve as communication hubs. A team of mobile robotic sensing platforms covering multiple ponds will offer significant cost reductions. Several different types of unmanned platforms have been evaluated as candidates in the HAUCS design. While each of these platforms offers some advantages, they all have deficiencies. Commercial off-the-shelf (COTS) aerial drones have become increasingly affordable and offer increased range and payload capacity. However, one fundamental limitation of these drones is their ability to operate under challenging weather conditions, especially in high wind. Unmanned surface vehicles (USVs) can operate under all-weather conditions. The USVs also provide broader spatial coverage of the pond. Unfortunately, the USVs will have similar issues to those that plagued the stationary sensor buoy biofouling,

C. HAUCS AUP Sensing Scheme

As discussed in Section I, one deficiency of buoy-based sensor stations is the lack of spatial coverage that can be achieved. Pond conditions may vary substantially at different locations in the same pond. Spatial and temporal variations of water quality parameters in three 0.4-hectare aquaculture ponds were investigated. It was concluded that locations within the pond were the highest source of variability. Spatial locations contribute to 75% of the variance of particulate carbon (PC), particulate nitrogen (PN), and 35% of the variance of total dissolved phosphorus (TDP). While DO was not tracked in this study, the result for TDP can be regarded as a proxy for DO due to the high correlation between TDP and DO. The contribution to the measurement variances from different locations can be expected to be even higher for large ponds (e.g., 2 to 8

hectares). This motivated the recent investigation of three-dimensional short-term DO spatial distributions. A combination of fixed sensor installations and measurements using handheld sensors at various locations in one pond were utilized in this study. The HAUCS framework, for the first time, will enable novel sensing schemes that cover extended spatial regions and provide more robust readings than traditional truck-based or buoy-based data collection processes. For example, to acquire DO sensor data, the sensor will need to be in contact with the water body for about 30 seconds. A potential scheme will be that when the platform first enters a new pond, the platform will be stationary at one location for up to 30 seconds before moving through the pond toward an adjacent pond. During the process, the sensor will stay in contact with the water body to collect a stream of water quality data (Fig. 3). This sensing scheme will effectively use the transition time to acquire significantly more data samples and capture the spatial variability of water quality in a pond. Fig. 3. Illustration of the mobile platform-based sensing scheme Another advantage of the agility of the HAUCS sensing platform is that the sensing scheme (i.e., sampling patterns, frequencies, areas of focus, etc.) can adapt to environmental and pond conditions. Such adaptations may be the result of the prediction model or weather changes detected by weather stations on the farm.

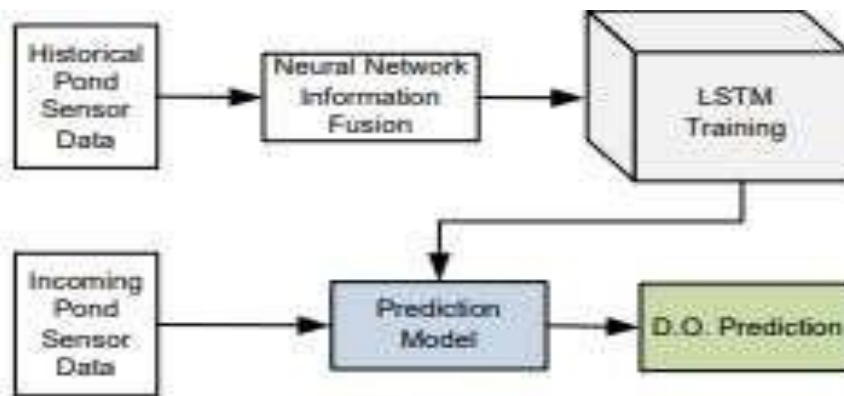


Fig 3.3: Hybrid NN LSTM DO prediction model.

D. HAUCS Communication Link

Central to the HAUCS design will be a need to ensure robust and flexible communication among HAUCS platforms, home stations, weather stations, and the control center, which will serve as the data aggregation hub. Coverage must

reach the whole farm, which can be large. For example, one of the large catfish farms - Tackett Catfish Farm at Greenwood, MS, has a span of 8km. While achieving long-distance communication, wireless transceiver must consume very little power to ensure operational longevity. Fortunately, given that the data to be collected is relatively low-dimensional and low-rate, the technology need not be high-bandwidth. These requirements are well aligned with LoRa standards and the latest LoRa chipsets from Appcon Wireless technology, Sem tech, and others. LoRa chipsets rely on chirp spread spectrum modulation in an unlicensed sub-GHz band (e.g., 915MHz). The latest radios are inexpensive (e.g., 30km line-of-sight), and consume very little power during transmission (e.g., 10mW). Given the relatively flat topography and limited land-cover of commercial aquaculture farms, these chipsets are expected to perform exceedingly well in the target environments.

E. Machine Learning Farm Condition Prediction Model

An ML prediction model will be adopted for farm pond condition prediction in the HAUCS framework. The primary focus will be the accurate prediction of DO concentration in each pond – the keystone pond health indicator in intensive aquaculture management. In the seminal work of Boyd et al., a simple graphical technique was adopted to use DO measurements made at dusk and in the early evening hours to predict DO concentration during the night and at dawn. This technique is still widely adopted on many fish farms and will be employed to provide reference predictions due to its broad adoption. However, the Boyd model does not consider many other environmental factors such as temperature, wind speed, wind direction, etc., due to the highly nonlinear relationships between the DO concentration and these factors. Various ML techniques, such as artificial neural networks (ANNs), have been adopted to develop more accurate DO concentration prediction models. The motivation is that ANNs can better abstract (or learn) the mathematical models of a complex ecological system such as a fish pond on an aquaculture farm. A least-squares support vector machine (LSSVM) was adopted in their prediction model in the studies by Juan et al. While LSSVM

offers some benefit over SVM regarding training speed, the lack of sparseness and robustness may reduce the prediction accuracy for real data sets. The Back Propagation technique adopted in has the problem of being sensitive to outliers. Another issue with all these techniques is that the models were validated with single pond data. Even though it was mentioned that monitoring was conducted on 120 river crab farms in, the analysis seemed to be conducted on one pond.

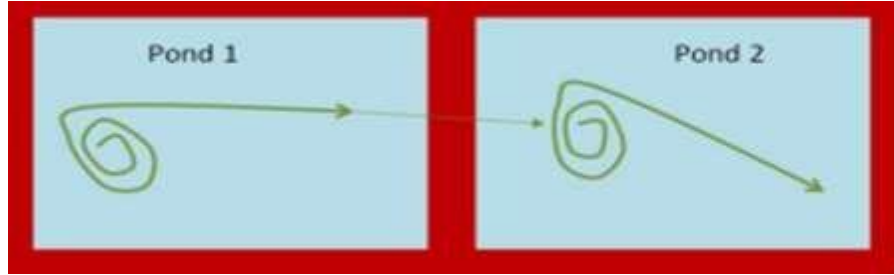


Fig 3.4: Illustration of mobile platform based on sensor scheme

The overall architecture of the proposed hybrid DO prediction model in HAUCS is shown in Fig. 4. A Long Short-Term Memory (LSTM) based recurrent neural network (RNN) is adopted. LSTM can provide better preservation of long-range dependencies in time series prediction. However, one challenge with LSTM networks is that they do not work well with incomplete data (i.e., gaps in the time series data). Unfortunately, incomplete data and missing data can be expected to occur in the field due to interference from various sources. To address this issue, a novel solution is adopted to train a feed forward neural network (FNN) to learn the patterns of the ponds and to predict the missing values. The structure of the missing DO value prediction network is shown in Fig. 5. The input layer includes vectors of the pond ID, time of day, weather, and a bias. The hidden layer is constructed with sigmoid functions, and the output layer produces the missing DO value for a specific pond at a specific time of day.

F. HAUCS Mission Control and Path Planning

We are presenting this current effort on developing a generic baseline algorithm here. A detailed report of the HAUCS mission control and path planning algorithm

development will be published in the future work. The mission control and path planning algorithm in the HAUCS framework is crucial to achieving the coordination among the HAUCS AUPs to provide persistent, accurate, and up-to-date situational awareness and to collaborate with the human operators to accomplish farm water quality control. The mission control will have to meet several challenges:

- Reaction to a pond in distress by increasing its patrolling frequency and dispatching mobile emergency aerators to that pond.
- Hybrid movements and flight mode transitions to adapt to terrain and weather.
- Capable of avoiding obstacles at fixed locations (e.g., fixed aerators) and moving obstacles (e.g., mobile emergency aerators or human-operated vehicles).

A baseline algorithm based on a hybrid control system has been developed to control and regulate the HAUCS framework. The architecture of the hybrid controller is shown in Fig 6. This includes a central server, operators, and individual AUPs assigned for each segment of the farm. The goal of HAUCS mission control is to provide path plans and maintain the traffic of deployed AUPs within the context of unmanned aerial system (UAS) traffic management. The central server in the control architecture provides information about weather and distress calls from ponds to the operators. The server also tracks and monitors the movement of AUPs in the deployed region to make sure that their paths do not intersect. Both the central server and operators can exchange information. Each server is connected to multiple operators. The algorithms also consider environmental conditions such as weather changes.

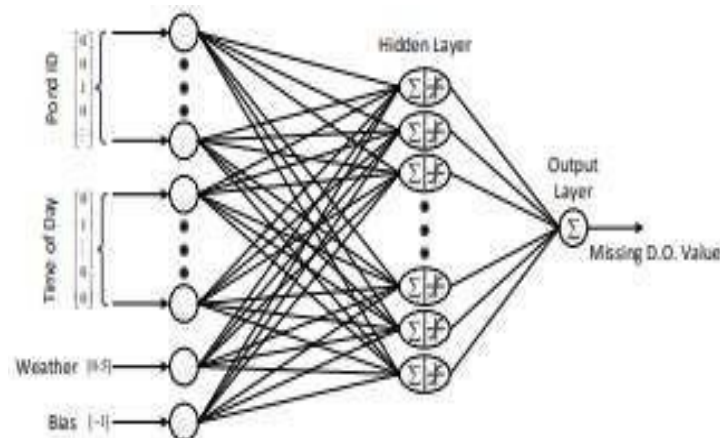


Fig 3.5: Multi-layer FNN for missing DO value prediction

The agents are instructed to make continuous and sequential movements without overlapping their paths. CPP is generally used in mapping, crop monitoring, and land assessment [57]. Approaches to CPP are categorized as randomized and complete. A randomized approach does not consider the geographical information of the farm and, therefore, takes a long time to cover the whole area. On the contrary, in a complete approach, the coverage area is decomposed into cellular regions, and an optimal path is traversed to cover all the cells (i.e., ponds). Details about cellular decomposition and optimal path searching can be found in [58, 59]. In the first phase of the work, the operator generates an optimal path plan for the AUP to cover a target area using the rotating calipers algorithm [65, 66]. The farm is defined as a convex polygon, $P = (V, E)$, where $V = \{1, \dots, n\}$ is the set of vertices of a polygon, and $E = \{(1,2), \dots, (n,1)\}$ is the set of edges. The starting/takeoff location and ending/landing location of the AUP is defined as x_s and x_e . The idea is to generate a back and forth flight pattern with waypoints, $W = (x_0, \dots, x_m)$ to cover the polygon. In a convex polygon, a line passing through the vertex such that the whole polygon lies on one side of the line is called a line of support. The pair of vertices that admit parallel lines of support are called antipodal pairs. The waypoint generation requires the computation of all pairs of antipodal points on the surface of the polygon. The algorithm then finds the best path for each antipodal pair. The best path is the one with the least back and forth flight lines, corresponding to the minimum width of the polygon. The algorithm selects the path having the lowest cost, with a computational complexity of $O(n)$. The later stages of the path planning can be broadly posed as:

- Area assignment of AUPs to cover the fish farm.
- Coverage planning of AUPs in cooperative fashion.

Finding the minimum number of vehicles to cover a region has been solved in [67] using an optimization approach. The anchored area partition problem has been discussed in [68] that facilitates coverage of a larger region by multiple vehicles. This would enable the AUPs to cover a larger region cooperatively. Other partitioning strategies can also be adopted for the initial assignment of different subgraphs (i.e., ponds) to each HAUCS AUP using offline Multilevel Subgraph Patrolling (MSP), a multilevel

partitioning algorithm [36]. For routine operations, the distributed Greedy Bayesian Strategy (GBS) scheme [37] is being investigated due to its excellent scalability, critical for large fish farms. Collision avoidance is critical in any path planning procedure. Artificial Potential Functions (APF) are a set of algorithms frequently used to navigate autonomous agents [60,61]. This method uses the concept of potential functions from magnetic and electric fields. Here, each vehicle or agent is taken as a point charge in space that gets attracted or repelled from nearby agents based on their distance. This results in a push/pull dynamic between agents. The attractive or repulsive force, typically defined as the negative gradient of a suitable potential function, is applied to each agent. Applications of APF can be found in path planning [60] and task allocation [61]. APF algorithms have high scalability and low bandwidth use [56]. The Traveling Salesman Problem (TSP) is a task allocation algorithm that generates an optimal path for an AUP to travel across some target locations with a minimum cost. It is an NP-hard problem in combinatorial optimization. If the AUPs have limited energy and limited weight carrying capacity, characterized as a Vehicle Routing Problem (VRP). Present applications of TSP/VRP algorithms are in package delivery and data collection [57]. Geofencing is a recent method of path planning that has found applications in UAS traffic management. In geofencing, airspace is divided into several zones used by an individual AUP or team of AUPs. This system is designed for traffic management across the growing number of AUPs in the airspace. Some scenarios of interacting geofences for multi-stage flight plans have been detailed in [62]. A geofencing based path planner is presented in [63]. Bio-inspired algorithms like Ant Colony Optimization are proposed in [64] for farmland monitoring. An adaptive approach to path planning of AUPs will also be investigated. The flight mode changes can be handled by location-based waypoints assignments: sampling waypoints (i.e., moving within the same pond) and transition waypoints (i.e., moving to a different pond or its home station on land). The control center will maintain the third type of waypoint – protective waypoints to cope with severe weather. For example, upon detecting the potential for strong winds, the control center can update the waypoints to protective

waypoints to allow the HAUCS AUPs to take evasive action such as operating as USVs. The control center can restore the waypoint status at a later time when conditions return to normal. The handling of the automatic emergency response will be centralized at the control center. Following the same logic of keeping emergency mobile aerators prepared for the potentially distressed ponds, each home station will store additional HAUCS AUPs as reserves. Once the prediction model detects a stressed pond, an automatic emergency response process will be invoked. The networked fixed aerators can be turned on; field operators may also be instructed to move the mobile emergency aerator in place. Escalation procedures will be in place to allow human intervention when all mobile aerators are in use. The patrolling frequency of the pond in distress will be increased by releasing the reserve AUPs to join the regular AUP. When the model detects that the distress is relieved, the aerators can be automatically switched off by the control center – critical for cost and energy reduction.

G. Land-based HAUCS Subsystems

In addition to the mobile platforms, the HAUCS framework will comprise land-based fixed installations. Environmental conditions, such as wind speed, direction, rainfall, etc., are needed in the DO prediction model and are also essential for the operation of the HAUCS platforms. Weather stations will be installed at strategic locations on the farm and integrated through the LoRa link. To improve the efficiency of HAUCS sensing platforms, automated maintenance home stations will be installed at various locations throughout the farm. These stations will fulfill the following tasks: a) automatic platform charging; b) automatic sensor maintenance (e.g., spraying fresh water, with an inexpensive wiper system integrated within the charging dock); and (3) serving as a communication hub when needed. With regard to home station deployment strategies, The initial plan will be to adopt the simplest solution: uniformly partitioning the farm into different operating zones and deploy one home station at the center of each zone. Alternatively, the home station placement can be formulated as an optimization problem to minimize the total energy cost, subject to constraints such as the

terrain and size of the farm, range limits of the LoRa links, weather conditions, etc. Therefore, the mission control and path planning algorithms discussed above will be highly relevant. In particular, the approach of interacting geofences for a multilayer partitioning discussed in [62] will be investigated. Automated charging is another critical aspect of HAUCS. Commercially available outdoor drone charging stations, such as the Heisha C200 outdoor charging pad [38], are being explored. To support the platform development, a gimbal harness was constructed. The six-degree of freedom movements allowed by this harness ensures the drone's pitch, roll, and yaw can be tested non-destructively on the stand (Fig. 8c). This harness allowed us to promptly identify potential issues in the platform structure and the flight controller software and speed up the development process. The coaxial drone was successfully demonstrated through flight tests in the open field.

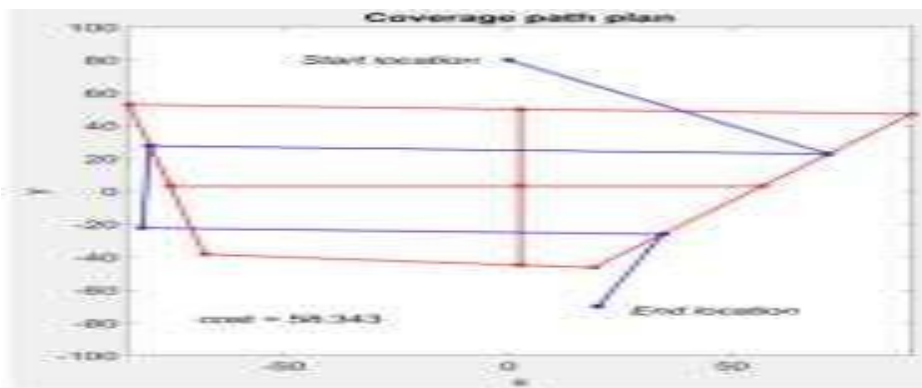


Fig 3.6: Sample path plan of HAUCS

A prototype based on the thrust vectoring coaxial drone concept is currently under development at the System and Imaging laboratory (SAIL) at HBOI/FAU. As highlighted in the CAD rendering in Fig 8a, the driving mechanism is provided by one contra-rotating rotor. The steering mechanism is accomplished by a gimbal controlled by two servos – a significantly more simplified mechanism than the T Drone. The prototype has a diameter of 10cm and a length of 45cm. The electronic control module is implemented using off-the-shelf components (Fig 8b). For flight control, the open-source Ardupilot [50] is loaded onto a compact Pixhawk PX4 PIX 2.4.8 Flight Controller. A rigid payload extension is adopted to improve the controllability of both the depth and the direction of the attached

sensors. Direction control will be crucial for electro-optical sensors such as underwater cameras that may be adopted for future tasks. The payload extension design is inspired by devices such as telescopic retractable straws or retractable fishing rod. The module consists of a series of nested tapered tubes, which rely on the sensor weight to extend and lock the rods in place. A micro winch is used to retrieve the rods and the instrument.

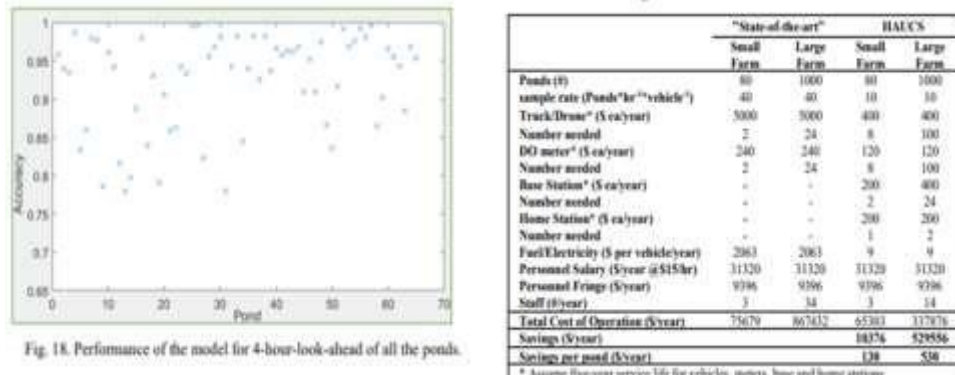


Fig 3.7: Performance of model & estimated annual cost.

A payload extension prototype has been developed as a proof-of-concept (Fig. 10a). The prototype consists of five sections. The length of each section is 10cm. The total extended length is 45cm. Since the mounting base is inside the frame (Fig 8a), the actual extension outside of the frame is 35cm. A dummy sensor was used while the DO and temperature sensors are being finalized. During deployment, a (full rotation) servo lowers the rods to form a rigid extension. To retrieve the module, the servo is operated in reverse. Multiple payload release and retrieval trials were performed successfully in the HBOI SAIL lab to validate the payload extension module design (Fig. 10b). While the current extension is relatively short, these laboratory tests showed that the nested, tapered, tube-based design is sound. The system was deployed on Logan Hollow Farm during September and October 2019. The distance between the office and the furthestmost pond is 2.12 KM. The LoRa heat map of the farm on 9/3/2019 is shown in Fig 13. There was no coverage in one strip (the marked area) where the tree-line blocked the line of sight to the farm office. Data from the ponds adjacent to this strip were collected by deploying sensors at different sections of these

ponds .While this system is only an interim step before implementing robotic sensing platforms, it helped the team gain firsthand experience of the LoRa network in the fish farm environment. More importantly, this system provides the farm with the tangible benefit of adopting an automated data acquisition system. This helps to reduce the barriers to the acceptance of robotic technology by the fish farmers. It is also worth pointing out that, while it is preliminary, the integration of the truck-based automated DO data acquisition with the HAUCS prediction model can have a direct and transformative impact on the fish farm operations. It is worth noting that the predictions for pond 26 were four-hour-look-ahead, and the predictions for pond 52 were eight-hour-look-ahead. The four-hour-look-ahead predictions for ponds 13 and 44 were less satisfying. One possible reason for the degraded performance might be that human interventions are not fully integrated into the model training. For example: If, the DO in a pond fell below a specific level aerators could be turned on to bring the DO back to the desired level. We will take these activities and other systemic factors into account in model training in future work. The four-hour-look-ahead MAPE of all the ponds is shown in Fig. 18. The prediction accuracy of the worst pond was 78%. The average accuracy was 92%. The accuracy achieved with the current prediction model is unmatched by the existing empirical formula-based technique. The development of the HAUCS system and deployment of the initial truck-based sensor system has led to significant improvement in fidelity of data collection that will improve farm water quality management. The current "state-of-the-art" data collection system being deployed on the farm without these improvements is crude and fraught with potential decision-making problems (e.g., transcription issues and paucity of data collected). The truck-based deployment eliminates the transcription and data storage issues plaguing the paper-based system.

3.2 CONCLUSION OF THE EXISTING SYSTEM

In this project, the concept of the Hybrid Aerial Underwater Robotic System (HAUCS) has been introduced. HAUCS is a transformative IOT solution that aims to achieve collaborative monitoring and decision-making on aquaculture farms of

varying scales through the collaboration of amphibious robotic platforms, land-based infrastructure, processing algorithms, and human operators. HAUCS overcomes many drawbacks in existing state-of-the-art aquaculture fish farm monitoring solutions, namely, the lack of sufficient spatial coverage of the ponds, sensors that are susceptible to biofouling, high deployment costs, and maintenance difficulties. HAUCS is a versatile system. In addition to fish farm water quality monitoring, the HAUCS framework can easily be extended and adapted for other environmental monitoring applications such as coastal zone surveillance. The integration of the payload extension will enable HAUCS AUPs to conduct missions in an energy-efficient way. The coaxial-rotor based prototype demonstrated great potential as the foundation of the HAUCS AUP. Extending the aerial platforms to a sail-driven USV will provide HAUCS AUP the all-weather capability and transform wind from an impediment to an energy source to power the AUP when operating in USV mode. The initial truck-based automated sensing system validated the HAUCS concept and provided a practical environmental monitoring alternative that is vastly more robust and effective than the current practice. This LSTM-FNN hybrid network-based DO prediction model has performed very well. Against the datasets from the Logan Hollow fish farm, it achieved an average accuracy of 92%. It is noteworthy that this model is robust against data gaps that can occur in the field due to interference from various sources. This work, therefore, laid a solid foundation to develop more sophisticated ML-based prediction models. As we advance, one of the future research foci will be to develop the amphibious HAUCS AUP and validate the performance with this collaborator – Logan Hollow Fish Farm. Developing land-based infrastructures, especially the automated charging solution, will also be another key area. The availability of the HAUCS AUPs will enable the investigation of different sensing schemes to optimize the spatial coverage of the ponds.

CHAPTER 4

PROPOSED SYSTEM

(Automatic Maintenance System using Wireless Sensor Node for Productive Aquaculture)

The proposed work will show that how much this project has been carried and completed. It can also show the different in system from existing one. In this system we are going to use the microcontroller for controlling and a GSM module to send the data over the cloud and store the result and take action over it.

As we discussed above that we are going to use different types of sensors and controller to male this system successful.

4.1 SYSTEM ARCHITECTURE OF ASMA

The proposed system architecture is given in the above Figures. Its functionality includes water quality check, environmental monitoring and power monitoring. The details are as follows. Water quality and environmental monitoring the requirement for water quality monitoring may include the temperature, OD, pH, Ammonium nitrate and Total dissolved solids. Water quality sensor possesses the ability to automatically collect data needed, have mutual communication, and output/display standardized characters. The water pump will be activated according to the decision made by these collected water quality information, whereas the water in the pond may be withdrawn to vary the pH or temperature.



Fig 4.1: Proposed System Real Time View

Subsequently, those aqua-farming creatures will stay in a good surrounding condition. Real time sensors for aquaculture are utilized in both freshwater and ocean water. By and large, sensors are utilized to screen basic natural parameters, for example, broke up oxygen, temperature and pH. They are additionally used to quantify supplement levels and the development of squanders, for example, smelling salts (NH_4^+) and carbon dioxide (CO_2). Such sensors are especially imperative in frameworks where water is recycled and where stocking levels are high. To be of most utilize such sensors are regularly connected to alerts activated when parameters, for example, broke up oxygen or temperature are estimated outside of safe points of confinement. Oxygen sensors can be connected to oxygen or air circulation banks to supply advantageous oxygen when required.

4.2 TYPES OF EQUIPMENT USED

- Temperature sensor,
- Ammonium Nitrate sensor (Na),
- Air Pump,
- Fish feeder,
- Microcontroller,
- IOT module and
- Application For output display.

4.3 WORKING SYSTEM

This device is used for controlling the system and taking necessary steps when it's needed. The sensor gives the data to microcontroller form where it is shared to GSM module in order to store the data into data collector and then it is processed through the cloud system. When the sensor sends the data to the GSM module by the microcontroller, we can see the data in real time monitor. The real time monitor data can be access through the internet over the cloud.

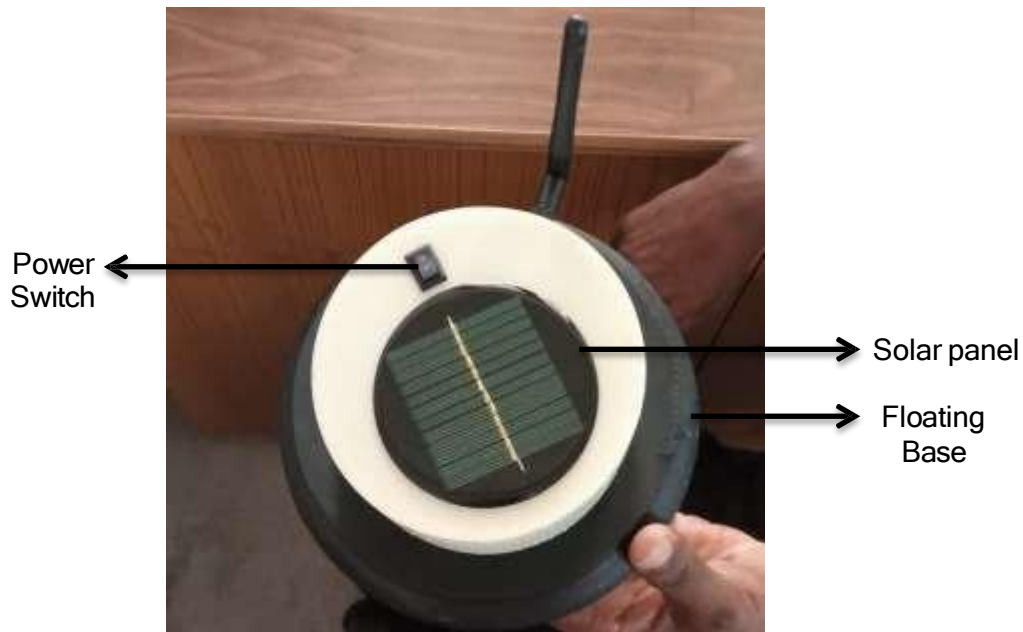


Fig 4.2: Proposed System Top Angle View

The real time monitor is being monitor continuously by the member, when the system detects toxic or harmful substance in the water bodies it will raise the alert and every member will get notify and then the member can take action remotely from anywhere if he is connected to the system. The sensor works as main system where it is connected to the microcontroller, when the sensor sends into the water it will start examine the water bodies the sensor can be send in the pond, natural water bodies or lager reservoirs like dams. Once it starts the exam it will take the temperature of the water, humidity, conduction, carbon emission, pH and dissolved oxygen. By, checking this we can determine the result of water whether it is safe and clean or it has some harmful substance in it.

4.3.1 Filtration Method

This method is one of the most important methods in maintaining the aquaculture farm or water condition. The Filtration method is easy to say but that what makes it harder to implement. Many farms of aquacultures doesn't conclude this as an important since it will be useless if the farm is in an open field, they think like if the pond where they are farming the fish is in open space the air will be more than enough for the fish to survive, but at rainy days or at the noon times

the air in the atmosphere will change its course drastically that will lead it to create strong wind or likely no wind pressure that can be absorbed in the water. This will create a less air circulation in water which can be caused or viewed as harmfulness for the aquaculture farming environment.

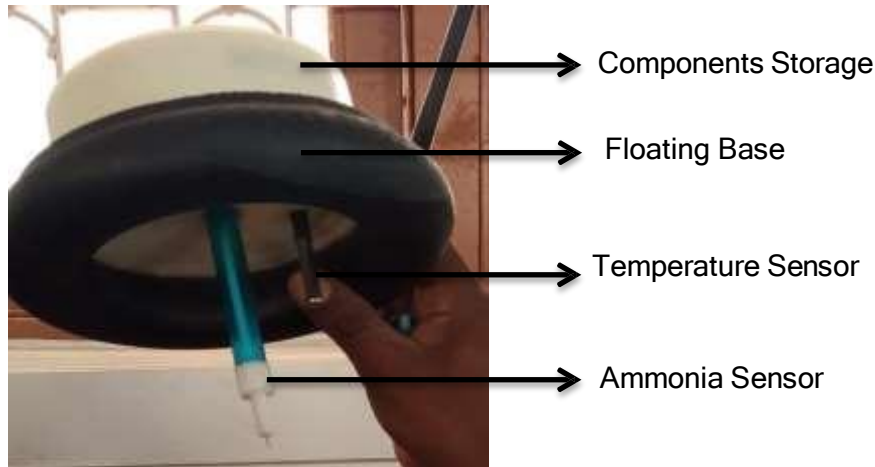


Fig 4.3: Proposed System Bottom Angle View

The maintaining of air circulation in the water is really important; now a day in every aquarium you can see large fish tank is equipped with larger size pump. The size of the pump should be calculated with the size of the tank or the area that it will be implemented with. The size of the pump should be directly proportional to the area of which the pump can efficiently filter the air and the area of the fishing tank or the aquaculture field area. The area can be either the pond or the open field where the fish can be farm easily without any disturbance; most of people prefer open area for farming because it has its own cons, while taking about cons it also include its own level of pros.

For your aquarium to stay healthy, filters are necessary. They maintain the nitrogen cycle and contribute to the wellbeing of the occupants of your tank. Anything inserted into a filter that modifies the quality of the water passing through it is called filter media. You can employ particular categories to modify the aquarium's environmental settings. Fish waste, sludge, leftover food, dust, and other unpleasant particles are all removed from the aquarium by mechanical filter media. The particles are squeezed out of aquarium water after it passes through a mechanical filter media. The filter medium needs to be cleaned frequently in order

to prevent build-up. The materials that make up mechanical media's components are inert, which means that they won't affect the chemistry of your water in any way. For your biological media to function effectively, this medium physically or mechanically filters particulates from water that passes through it. It merely requires cleaning; replacement is only necessary when it can no longer completely release the filth it retains. Many various porosities of mechanical media are accessible, and these porosities regulate the size of you can extract the particle. The larger the particle matter must be for the filter to extract it, the larger the pores in the mechanical media must be. Compared to finer media, this kind of coarse media is simpler to reuse and clean. One micrometer, or 1/90 the diameter of a human hair, is the smallest particle that the pores in the finest mechanical media can filter out. The finest media will clear the tank, but it won't last long before it becomes clogged and can't be used again. Anything inert that serves as a home for nitrifying bacteria, which transform nitrogenous contaminants into less hazardous forms, is referred to as a biological medium. Unless it has become too clogged to operate, this media shouldn't need to be replaced. Oxygen is taken from the water that is flowing by nitrifying bacteria. Particulate matter that enters the media and lowers water flow "starves" that region of oxygen and nutrients, which kills nitrifying bacteria there. Because of this, mechanical media are advised above biological media. The concentration of ammonia and nitrite encourages bacterial reproduction as the bio load rises. As soon as the ammonia level reaches zero, nitrifying bacteria begin to rapidly proliferate. They can create too much, leading to "bacteria blooms," which give the aquarium a murky or smoky appearance. The cloudy tank water clears up once the right number of bacteria's has developed to combat the ammonia rise, starving and dying excess germs. A bacterial bloom appears in an established aquarium is less likely to occur, and any ammonia surges can disappear in 24 hours, frequently before you even have the chance to conduct an ammonia test. The quantity of fish and bacteria in new aquariums affect how long it takes for bacteria to convert ammonia. The nitrogen cycle is supported by bacteria found in biological medium. It gives the helpful nitrifying bacteria more surface area to colonize and allows water to move through

the colonies, giving nutrients and oxygen needed for the nitrogen cycle. If the aquarium hasn't been treated with drugs or other chemicals, a scoop of surface gravel from an established, healthy aquarium or some bio media from the filter can serve as a beneficial supply of bacteria. A bacterium is an alternative. Except by excessive cleaning, the use of chlorinated water, or the use of specific drugs, it is difficult to eradicate germs after they have established themselves in biological media. The nitrite that the ammonia-eating bacteria produce when they ingest ammonia is subsequently taken up by the nitrite-eating bacteria. These bacteria take longer to multiply and would rather wait until there is no more ammonia in the environment. There are numerous medium options for harbouring bacteria. Small biological mediums have enormous surface areas and are very porous. They have a limited surface area yet can hold a lot of bacteria. Inadequate mechanical filtering might cause them to readily clog and lose their effectiveness. Smaller media are a great choice if you have limited room in your home or office because they last 2-4 years. filter. Although plastic media, like bio balls, don't have as much surface area, they are less prone to clog and never need to be replaced. It is understandable why aquarists insist on using at least a minimal amount of mechanical and biological media for filtering. They cooperate to maintain a stable, reliable, and healthy ecology.

4.3.2 Conditions of water Measured

Nitrate in aquarium Ammonia, a typical waste product discovered in fish tanks, produces nitrate as a byproduct. It derives from aquatic vegetation, old food, and fish waste. The bio filter in your fish tank is made to break down ammonia into components that fish are more tolerant of because ammonia is particularly poisonous to fish. Even though fish can tolerate nitrate in their water considerably better than ammonia can, too much nitrate can still be hazardous. Nitrate accumulation is facilitated by waste materials in the water. Overcrowding of fish in a tank and overfeeding of the fish, which causes the fish to create more waste, are some of the prevalent issues in tanks with a lot of waste and, consequently, a

lot of nitrate. Since they no longer effectively break down ammonia, dirty or aged fish tank filters can also cause nitrate buildup. Finally, an overabundance of nitrate may result from decomposing plant debris. If you utilize live plants in your aquarium, be sure to routinely clear out their leaves and replace any that have died.

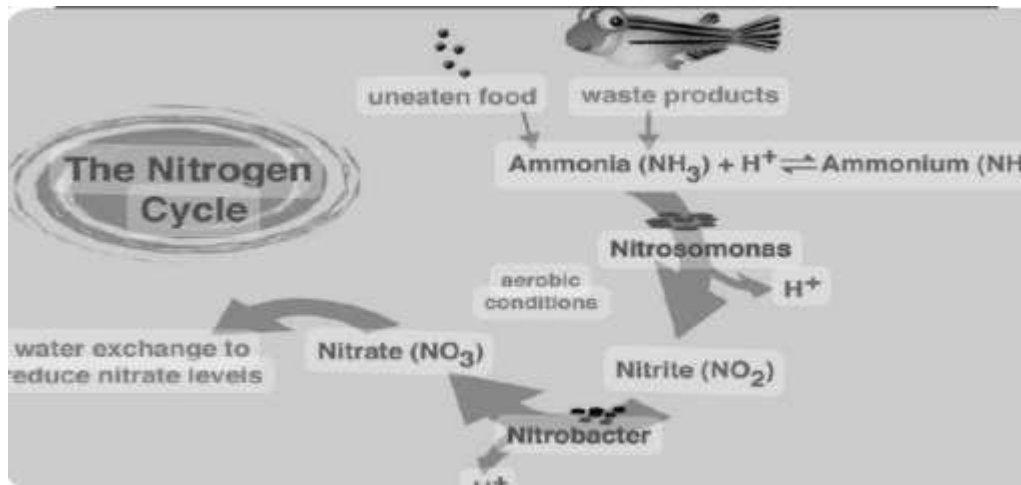


Fig 4.4: Nitrogen Contamination Process

Contamination of water is due to so much of different thing, it includes nitrogen ammonia which is explained in above, the next is solid which is dissolved in water from various sources

4.4 SCHEMATIC DIAGRAM

The schematic diagram of any system shows hoe\w the hardware devices are connected with each other, now the connection in this will be more accurate since the diagram shows the exact pin of one electronics components is connected to other components pin

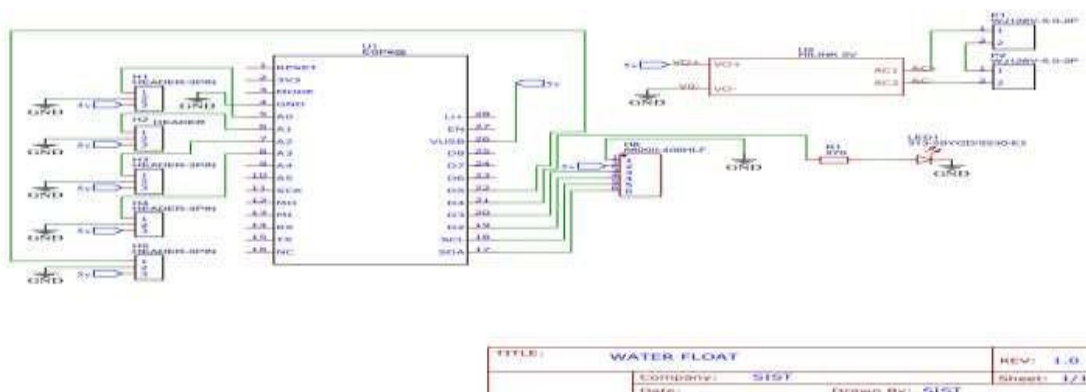


Fig 4.5: Schematic Diagram

4.5 HARDWARE DESCRIPTION

Temperature sensor:

By changing resistance in a proportionate manner to temperature, RTD sensors are used to measure temperature. RTDs are made with both fundamental temperature components and fully assembled assemblies. These so-called RTD probes are made up of an RTD sensor element, housing or sheath, epoxy or filler, extension leads, and occasionally a connector or termination. Based on the material compatibility, accuracy, and measurement range needs of the customer, a variety of sensor materials are offered. The ability to create the best RTD temperature sensors for a number of applications is made possible by standard packaging as well as unique designs.



Fig 4.6: Temperature Sensor

RTD temperature probes and sensors can be used in a wide range of applications across numerous sectors. With numerous agency clearances, these temperature sensors can function on board level components as well as in tough and dangerous environments. Our wide range of temperature devices satisfies the unique sensing requirements of vital OEM applications, such as those in the medical, aerospace, automotive, instrumentation appliances, motor control, and HVAC/R industries.



Fig 4.7: Ammonia Sensor

Ammonia sensor

The Ammonia sensor MQ-137 from winsen is a gas sensor for ammonia (NH₃). In pure air, SnO₂, the sensing element, has a lower conductivity. As the gas concentration rises, the sensor's conductivity also rises, indicating the presence of NH₃ (ammonia) gas.

Air pump

The system is also integrated with high end Air pump, by collecting Information of temperature and NA values present in the water the end user can on or off the air pump by any far distance and ay time with ease as they feel.



Fig 4.8: Air pump for filtration

Fish feeder Aquarium fish feeders are electric or electronic gadgets made to feed fish in aquariums on a schedule. When the aquarist is away on vacation or is too busy to keep up a regular feeding schedule, they are frequently employed to feed fish.

Microcontroller (ESP32)

A microcontroller is a tiny integrated circuit that manages only one process in an embedded system. A typical microcontroller contains a CPU, memory, and input/output (I/O) peripherals on a single chip. Microcontrollers, often referred to as embedded controllers or microcontroller units (MCU), are used in a wide range of products, such as robots, office supplies, medical equipment, and vending

machines. These are essentially simple mini-personal computers (PCs) that are used to control small portions of larger components without the need for a complex front-end operating system (OS).



Fig 4.9: ESP32 microcontroller

Solar Panel

This system is also including a small solar panel device plate which is enough to charge a full 9v battery and make it reuse. The solar is directly attached to iot board which converts the light energy to electrical and make it possible to store in the battery for reuse it again. Mini solar panels provide a source of renewable energy; as such, they offer an alternative to energy sources that have environmental costs, such as the emission of greenhouse gases. Although mini solar panels might prove expensive to purchase, solar energy saves money on power bills over the long run because there is no cost for the sunlight that they use to generate power.

4.6 BLOCK DIAGRAM

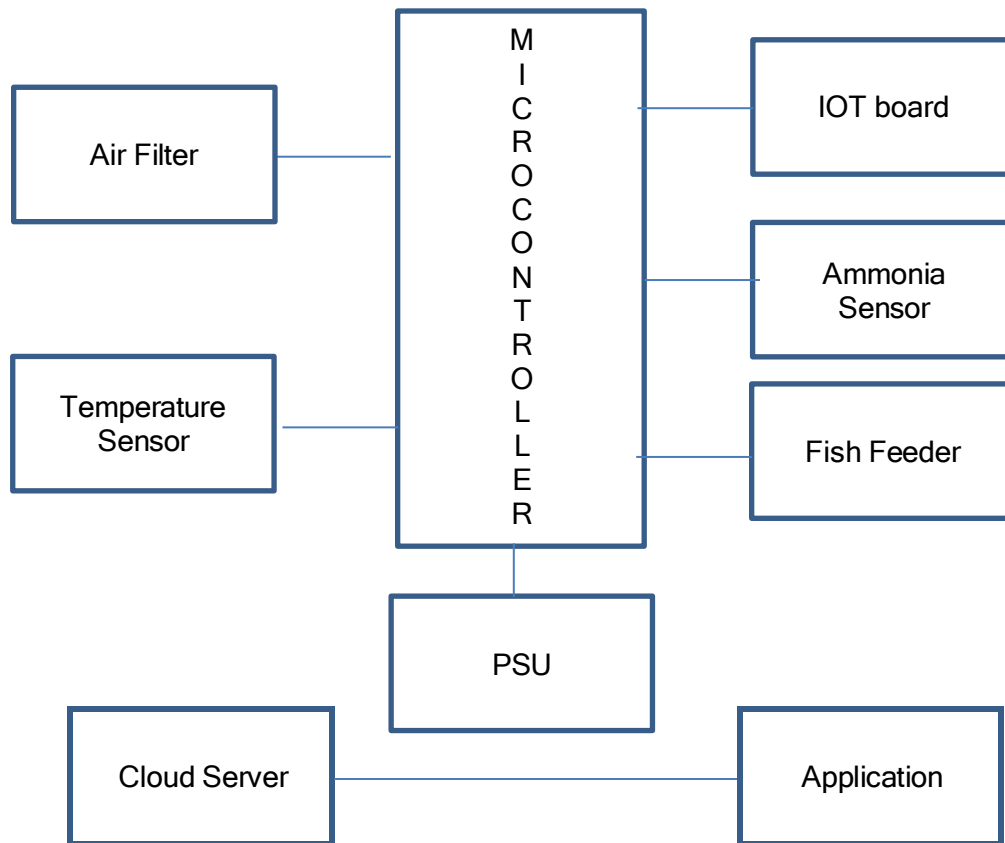


Figure 4.10: Block diagram of Automatic Maintenance System using Wireless Sensor Node for Productive Aquaculture

The above is the block diagram of this project components used in this proposed system AMSA. The proposed system can upgrade aqua-farming technology, reduce carbon emission, energy saving, and alleviate the problem of the overdrawn freshwater from aquifers.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 REAL TIME DEPLOYMENT SETUP

Connection of the above hardware components are made as per the requirements, the monitoring system is fully based of automatic system which is connected to the application through the cloud server, the application and the cloud is connected to make the possible exchange of information using Wi-Fi or internet to keep the data new and updated time to time parallel to Real time. In mean time the sensor does its work, the work if sensor is to detect the certain chemical values which could be present in the water all along. The main system is to find the temperature and Ammonia values in order to find the correct possible values for the aquaculture framing is safer. Now a days where food demand is growing the more chemicals reaction is to be occurred. The occurred values will be sent to the cloud by using the iot devices and then it will be or it can be viewed by users or owners of the application, the application should be easy enough to be get handled by every farmers who doesn't or cannot have the knowledge of understanding the growing world, so that's kept in we mind we have been use a third party application which is user friendly and understandable easily. The implementation consists of different types of sensor which is used for collecting many different values like ph, tds, oxygen, and temperature and nitrogen ammonia



Fig 5.1: Implementation Setup

The system can be either used for checking the condition of water or for used in aquaculture farming.

Case 1: Small water bodies

If the water bodies is like small canal, pond or well we can simply use it on the site to check the water quality.

Case 2: Large water bodies

If the water area is like bigger than 1km i.e) small lake, big pond, small water fall we can use the system as in floating product to gather data.

Case 3: Aquaculture Farming area

In this case we need to continuously check the water condition and feed the fish time to time approximately.

First the system will be assembled as layout design. The device will be immersed in water. After that it will start collecting data of water. Data's like water temperature, water ammonia level, water ph level, water oxygen level, etc...The data will then transmit to the cloud server(base.st) After reception of data the server will analysis it with initial data. On that time if data does not match with initial data, it will raise an alert to owner. After the alert the owner can either manually work on it or system will automatically take the action. This process can be fully automatic and self-maintenance system with wireless node for communication.

When the sensor sends the data through lot borad by the microcontroller, we can see the data in real time monitor. The real time monitor data can be access through the internet over the cloud.

The product is created with material which will make it easy to float in water with only sensors being immersed

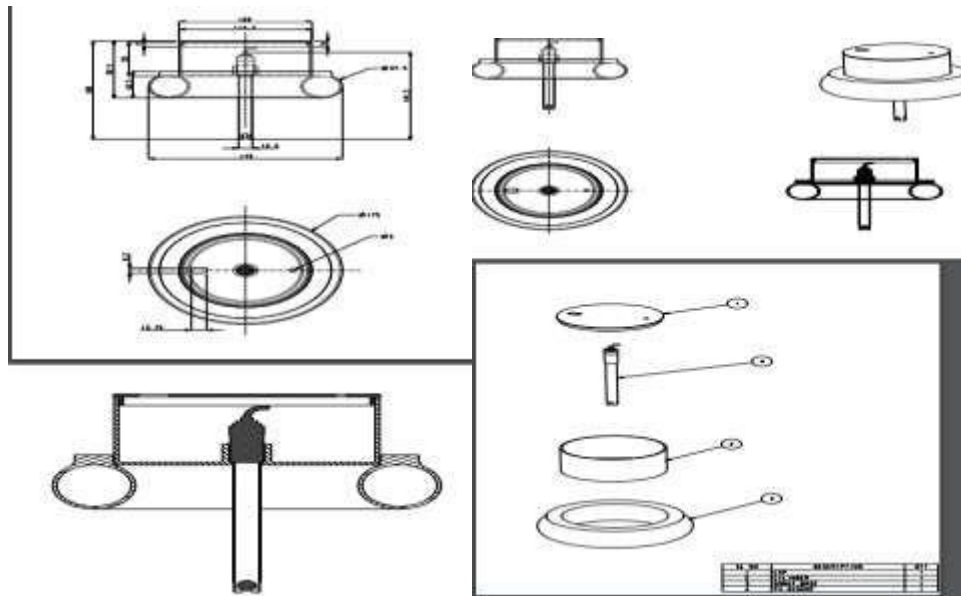


Fig 5.2: 3D Built in structure

This project is based on simple design by using which the system base of the system is built on 3D so that it can easily float on water without any restriction, this system or the product will follow the flow of water. As we can see the upper half or the top front is round hollow so we can setup the development boards in it easily. The bottom half of the system or the product is consist with a small holes so we can pass the nose of sensor through it and the Antenna of IOT boards so it can connect through the cloud to network for steady flow of data set values which has been collected from sensor immersed in the water.

5.2 ALGORITHM USED

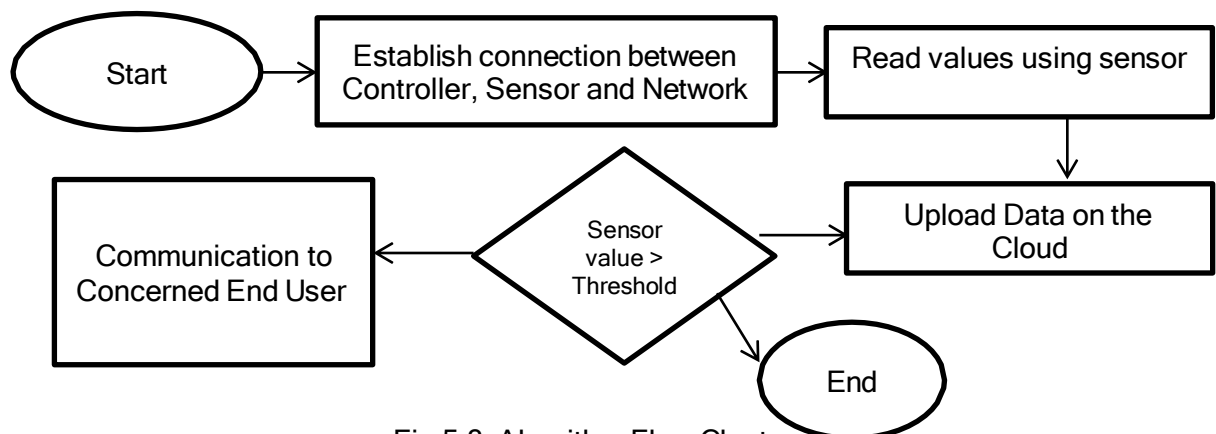


Fig 5.3: Algorithm Flow Chart

5.3 ADVANTAGES AND APPLICATION OF PROPOSED SYSTEM

ADVANTAGES

- Real time data and information of water condition
- Reduction in cost and man power
- Easy to implement and use it efficiently
- Monitoring and data transferring is in efficient way because usage of wireless sensor node
- Broad range of transmitting
- Low power consumption because of solar panel

APPLICATION

- Used in Small pond, dam and reservoir.
- Applied to detect the water condition
- Applied to increase the oxygen
- Applied to check the ammonia level
- Applied to check the contamination of water
- Helping in making the aquaculture production increase and easy.

CHAPTER 6

RESULT

The system is based on the Internet of Things; it is on the basis of internet of thing because the whole system runs on exchange of information through the cloud channel and making it possible to do the required work in time. The system can be also called as system based on real time, since the values which is acquired from the sensor immersed in the water is shown in the real rime values. Now let's take the result, the system Automatic Maintenance System using wireless System Node for Productive Aquaculture is the product or a system of its on able to float on the surface of water and frequently taking the values of Temperature, Air Filtration and Nitrogen Ammonia present in the water by using the sensor which is immersed in the water.

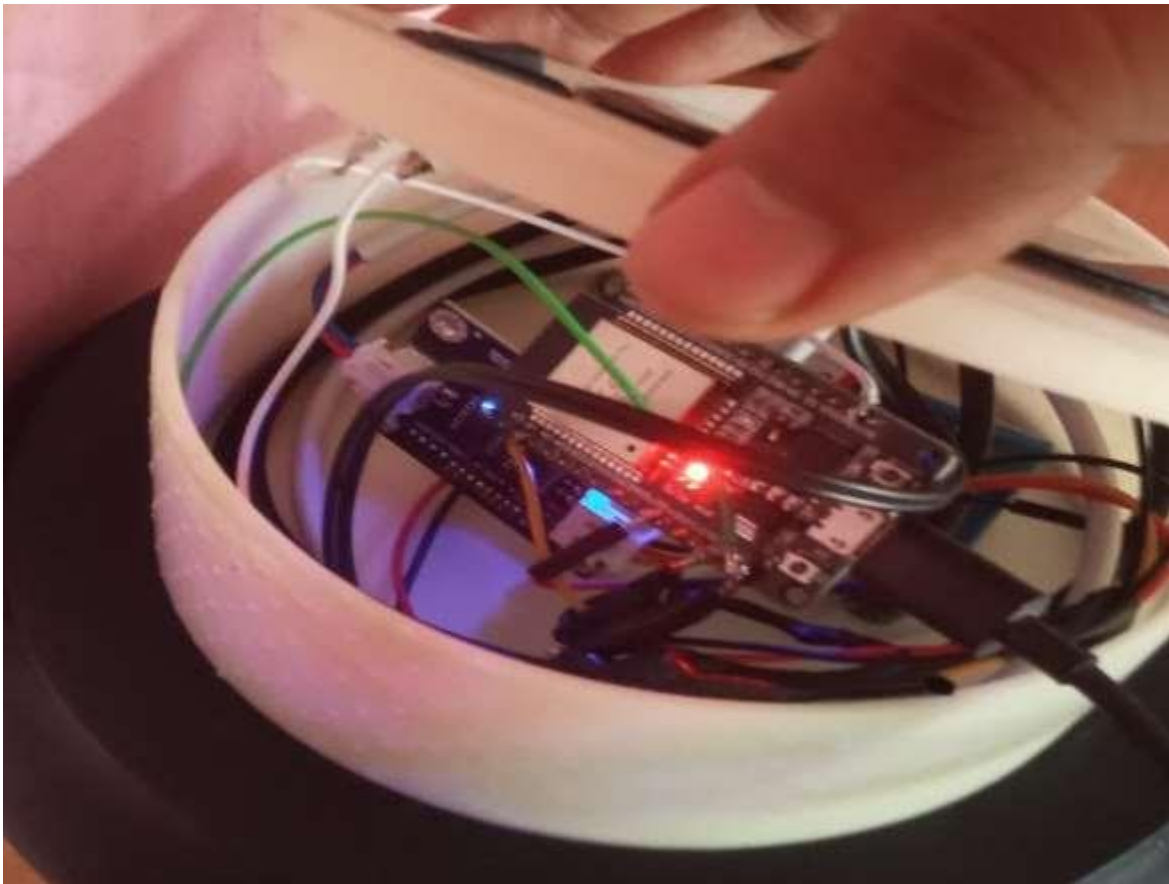


Fig 6.1: Automatic Maintenance system real time product

6.2 OUTPUT OBTAINED

In the above figure 6.1 it has been clearly shown that the real time product of this

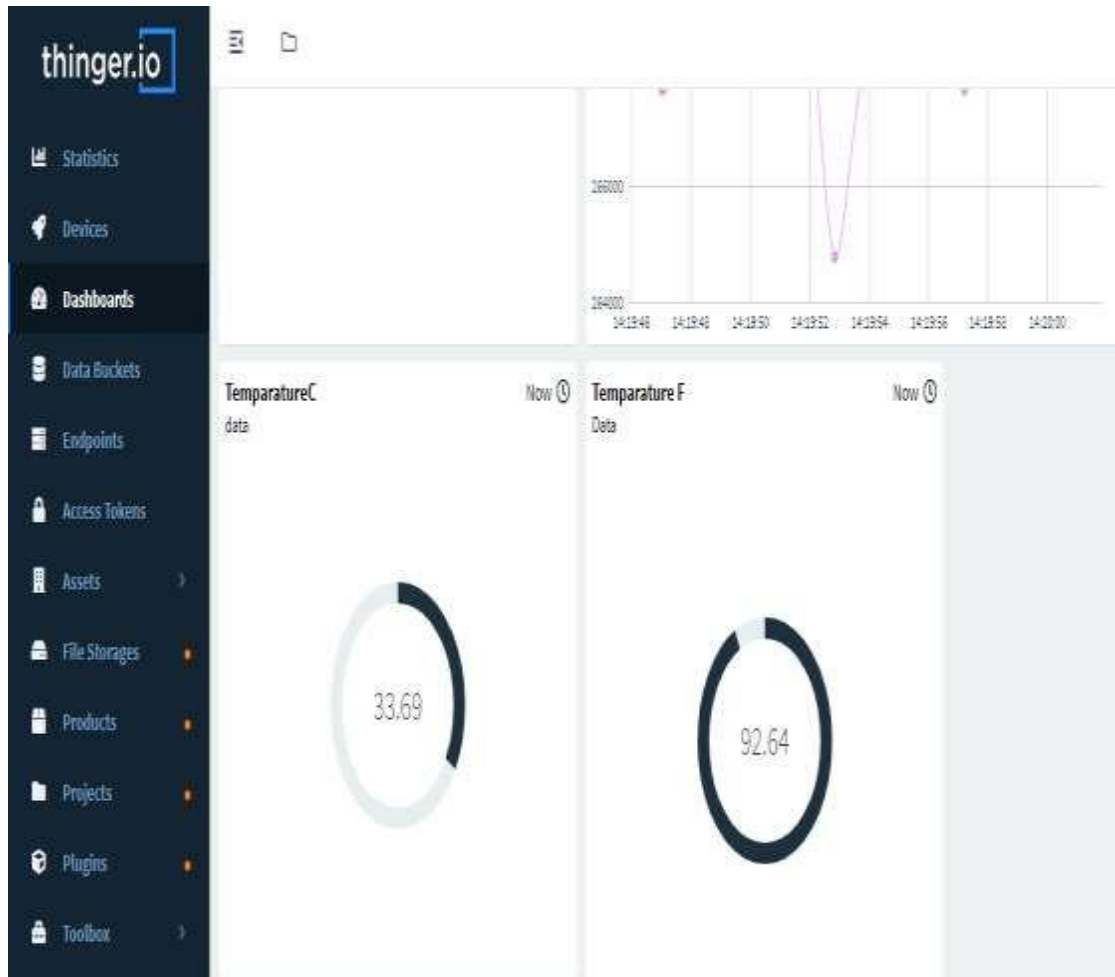


Fig 6.2: Automatic Maintenance system Temperature reading

For the automatic maintenance system the output is shown on a platform called thinger.io, it is a cloud platform which is specially used for showing the results and values obtained by the sensor and then compare it with the threshold values. The above output of temperature is shown on thinger.io. Its an simply third party app but secured with password.

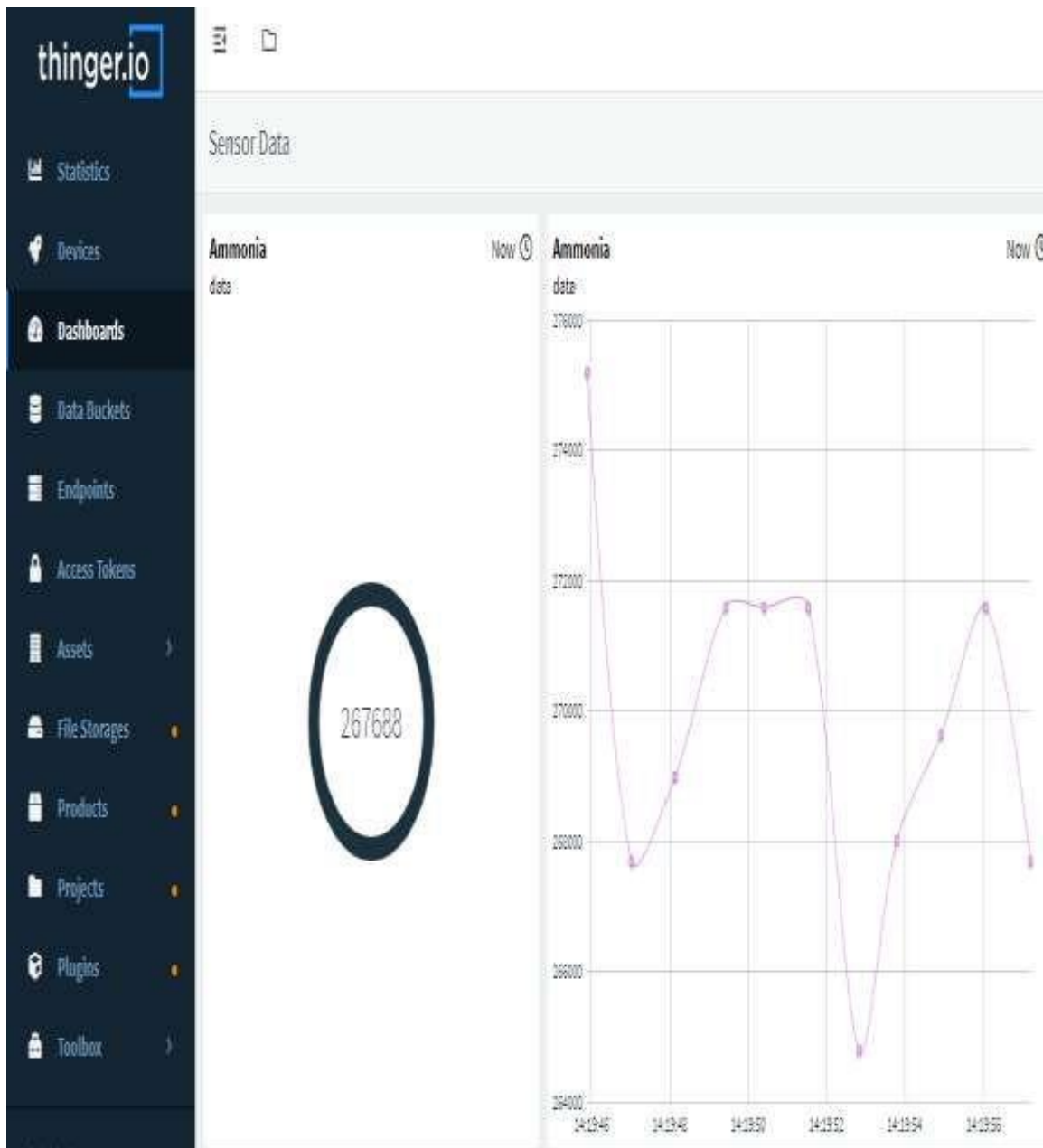


Fig 6.3: Ammonia Level indication with its analog data

The system is checking ammonia level for the water and constantly sending it through real time with its analog graphical data in which its clearly shown how the content of water changes with time and its temperature also, temperature also play important role in increasing and decreasing the ammonia level.

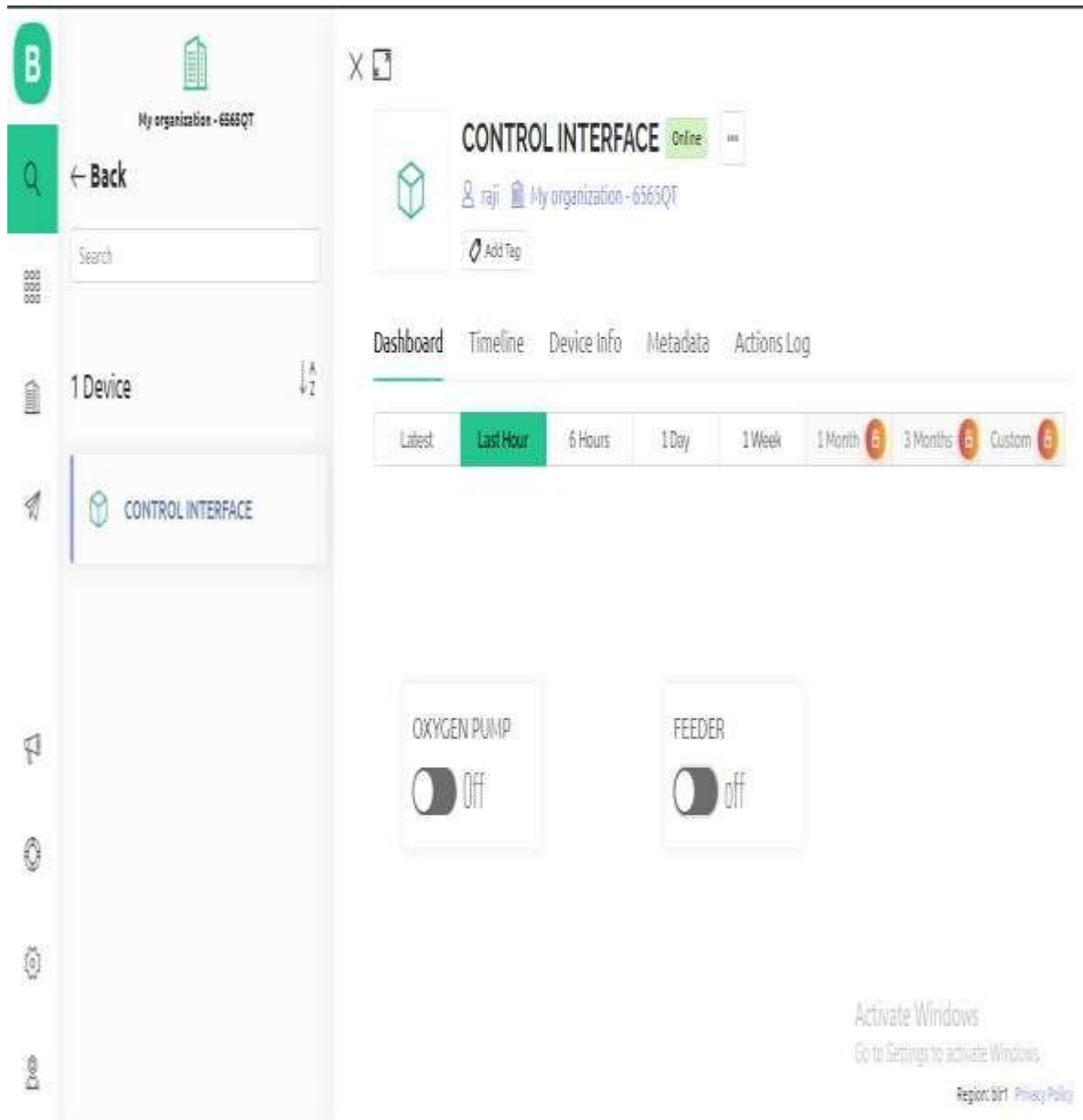


Fig 6.4 Controlling system for feeder and oxygen pump

The system can be used for controlling the feeder and the filtration by far away with single click and the feeder can be used for user to feed there fish and aquaculture products very easily. By using this anyone can greatly reduce wastage of fish food and creating the ammonia and many more harmful substance like this in water with reduction in the wastage of uneaten food by fish,

CHAPTER 7

CONCLUSION

Fruitful aquaculture generation is estimated as far as financial, social, physical or organic, and supportability. Aquaculture includes not only fishes but also the creatures whose life is depending on water sources. By cleaning and monitoring the water bodies continuously we can regulate and fight against the water-based issues.

The System, Automatic Maintenance System using Wireless Sensor Node for Productive Aquaculture (AMSA) has developed. The framework can “control the adjustments in water parameters, like dam, reservoir, tank state and fish conduct amid the encouraging procedure”. The observed water parameters are the temperature, conductivity, turbidity, and the nearness of oil layer over the water. User can access the system via the Internet (cloud), meanwhile lowering the risk of facing so many uncontrollable/unpredictable situations outdoors.

The surrounding of aqua farming ponds and increasing the survival rate and production of marine live and fishes. The sensors appeared in this paper can be utilized to improve the productivity of the aquaculture. The sensors are made out of basic electronic parts. Every one of the sensors has been adjusted and their appropriateness for the aquaculture observing has been uncovered.

FUTURE WORK

The future scope of the project can be focusing on the floating base, the scope will be to move the floating base around the whole water surface area like boat and control it easily. The system can also get so many type of upgrade like self-maintaining and processing

[REFERENCES]

[1] Bing Ouyang, Member, IEEE, Paul S. Wills, Yufei Tang, Jason O. Hallstrom, Tsung-Chow Su, Kamesh Namuduri, Srijita Mukherjee, Jose Ignacio Rodriguez-Labra, Yanjun Li and Casey J. Den Ouden, DOI 10.1109/JIOT.2021.3068571,2021. For Initial Development of the Hybrid Aerial Underwater Robotic System.

[2] S. Balakrishnan, S. Sheeba Rani, K. C. Ramya, Professor, Department of Computer Science and Engineering in the year 2019, Volume 13, Number 1 (2019), pp. 121-127. For Design and Development of IOT Based Smart Aquaculture System.

[3] Fariza Halidatsani Azhra, Chaerul Anam, they are electrical engineering from Islamic university of Indonesia, Yogyakarta, Indonesia, ISSN (2354-6026). For IOT based Automatic Fish Pond control System.

[4] C.W. Hsieh, Y. J. Tsai, C. Stefanie, C. C. N. Wang and W. -T. S. Chang, "The Preliminary Design of Water Quality Monitor System for the Ecological Pond based on LoRa WAN," 2020 International Symposium on Computer, Consumer and Control (IS3C), 2020. For the Preliminary Design of Water Quality Monitor System for the Ecological Pond based on LoRa WAN.

[5] L. Yunfeng and Z. Tianpei, "A Design of Dissolved Oxygen Monitoring System Based on Nb-IOT," 2019 International Conference on Smart Grid and Electrical Automation (ICSGEA), 2019, pp. 98-101, doi: 10.1109/ICSGEA.2019.00030. For A Design of Dissolved Oxygen Monitoring System Based on Nb-IOT.

[6] G. S. Menon, M. V. Ramesh and P. Divya, "A low-cost wireless sensor network for water quality monitoring in natural water bodies," 2017 IEEE Global Humanitarian Technology Conference (GHTC), 2017, pp. 1-8, doi: 10.1109/GHTC.2017.8239341. For A low-cost wireless sensor network for water quality monitoring in natural water bodies.

- [7] C. Liu, L. Wang, B. Li, S. Wang and Y. Du, "Analysis of Water Temperature Stratification and Water Quality Response Mechanism of Daheiting Reservoir in Tangshan City," 2018 3rd International Conference on Smart City and Systems Engineering (ICSCSE), 2018, pp. 849-854, doi: 10.1109/ICSCSE.2018.00183. For Analysis of Water Temperature Stratification and Water Quality Response Mechanism of Daheiting Reservoir in Tangshan City.
- [8] M. Sabari, P. Aswinth, T. Karthik and B. Kumar C., "Water Quality Monitoring System Based on IOT," 2020 5th International Conference on Devices, Circuits and Systems (ICDCS), 2020, pp. 279-282, doi: 10.1109/ICDCS48716.2020.243598. For Water Quality Monitoring System Based on IOT.
- [9] P. Tokekar, J. V. Hook, D. Mulla and V. Isler, "Sensor planning for a SymbIoTic UAV and UGV system for precision agriculture," IEEE Trans. Robot., vol. 32, no. 6, pp. 1498-1511, 2016, doi: 10.1109/TRO.2016.2603528.
- [10] K. R. Aravind, P. Raja and M. Pérez-Ruiz, "Task-based agricultural mobile robots in arable farming: A review," Span. J. Ag. Res., vol. 15, no. 1, pp. 1-16, 2017, doi: 10.5424/sjar/2017151-9573.
- [11] N. Michael, E. Stump and K. Mohta, "Persistent surveillance with a team of MAVs," in 2011 IEEE/RSJ Intl. Conf. Int. Rob. Syst., (IROS), pp. 2708-2716, 2011, doi: 10.1109/IROS.2011.6095174.
- [12] O. Elijah, T. Abdul Rahman, I. Orikumhi, C. Y. Leow and N. Hindia, "An overview of the Internet of Things (IOT) and data analytics in agriculture: Benefits and challenges," IEEE Internet Things J., vol. 5, no. 5, pp. 3758 - 3773, 2018, doi: 10.1109/JIOT.2018.2844296.
- [13] N. Zhao, H. Deng, C. Wang, K. Li and S. Jia, "Design and dynamic modeling

of a coaxial-rotor system," 2016 8th Intel. Conf. Mod. Ident.Cont. (ICMIC), Algiers, 2016, pp. 989-994, doi: 10.1109/ICMIC.2016.7804258.

[14] D. Portugal and R. Rocha, "MSP algorithm: Multi-robot patrolling based on territory allocation using balanced graph partitioning," in Proc. of Symp. Appl. Comp. (SAC 2010), Sierre, Switzerland, 2010, pp. 1271-1276, doi: 10.1145/1774088.1774360

[15] Y. Liu, R. Lv, X. Guan, and J. Zeng, "Path planning for unmanned aerial vehicle under geo-fencing and minimum safe separation constraints," 12th World Congress on Intelligent Control and Automation (WCICA), 2016, doi: 10.1109/wcica.2016.7578482