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IOT based Aquaculture Monitoring System

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Abstract: The Smart Fishpond Monitoring System's main objective is to check the quality of the water by using pH, turbidity and temperature sensors. As the conventional system has some shortness in practise, this is done in Internet of Things (IoT) and some additional features have been included in this system for efficient management. In most of the aquaculture industries, manual water quality monitoring test is employed in order to assess the water quality of the pond. Only trained personnel can conduct the test. Test will need to be repeated if samples used are spoiled or no longer usable. Thus, the process is time and cost consuming. Fish is an important protein rich food resource. there has been sharp increase in demand of fish products due to increasing population pressure in this century. Thus, to meet the demand of present food supply, water quality management in fish pond is a necessary step that is required to be taken up. The graphical user interface was designed, so that the users and investigators can observe, investigate and analyze the related data. The user interface allows us to convey the analyzed data in the form of a message to the users in their respective local languages to their Mobile Phones and alerts them in unhygienic environmental condition.

Keywords: Internet of Things (IoT), pH, Arduino,ISP,WiFi

I.INTRODUCTION

Fish culture is the farming of aquatic organism in natural or controlled marine or freshwater environments. Since 20 years ago, aquaculture industry is blooming rapidly and it has been identified as the most popular method in fishery sector. However, one of the pertinent yet persistent issues faced by aquaculture farmers is how to efficiently monitor the water quality of their ponds. Maintaining water quality is vital as it is the most important factor in determining the success and failure of the aquaculture farming. Many fish, shrimp and shellfish have been found dead due to eutrophicated aquaculture ponds and unbalanced ecosystem of the aquaculture water. Also fish is an inexpensive source of protein and an important cash crop in many regions of world. Water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion. Water quality is one of the important factors to be considered for the distribution, production and reproduction of fish and other aquatic species and at times it may get affected either directly or indirectly. Many workers have reported the status of water bodies after receiving various kinds of pollutants altering water quality characteristics (physical, chemical and biological). Fishes are cold blooded creatures and any variation in temperature of water hamper the growth of fishes. Due to abnormal growth of algae and phytoplankton the oxygen level decreases and as a result the fishes might not get enough oxygen which may decreases their chances of surviving which makes dissolved oxygen also an important water parameter. Too much acidity or alkalinity may impact the fish skins, water plants.

All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions. Each water quality parameter alone can directly affect the animal's health. Exposure of shrimp and fish to improper levels of dissolved oxygen, ammonia, nitrite or hydrogen sulphide leads to stress and disease. However, in the complex and dynamic environment of an aquaculture pond, water quality parameters also influence each other. Unbalanced levels of temperature and pH can increase the toxicity of ammonia and hydrogen sulphide. Thus, maintaining balanced levels of water quality parameters are fundamental for both the health and growth of culture organisms. It is recommended to monitor and assess water quality parameters on a routine basis.

A. IMPORTANCE OF WATER QUALITY TO AQUACULTURE

Water is a 'universal solvent' where various chemical dissolved in the water, as well as all physical attributes affecting them combined to contribute to the water quality. Good water quality level is determined by all attributes present in the water at an appropriate level and not outside tolerable range. Often aquaculture water quality does not equal to environmental water quality. Therefore different parameters are used in monitoring aquaculture farm as compared to environmental water quality.It is also more often that good water quality criteria differ from species to

species. Physical, chemical, and biological properties are interrelated and it affects survival, growth, and reproduction of aquaculture. Aquaculture can also have reverse effect to the environment as aquatic organisms consume oxygen and produce byproducts, carbon dioxide and ammonia. Important water quality parameters to be considered are; temperature, salinity, pH, DO, ammonia, nitrite/nitrate, hardness, alkalinity, and turbidity.Careful monitoring of water quality is important to understand the interactions between parameters and effects on shrimp and fish feeding, their growth and health. Each water parameter alone may not tell much, but several parameters together can reveal dynamic processes taking place in the pond. Water quality records will allow farmers to note changes and make decisions fast so that corrective actions can be taken quickly.

B. QUALITY OF FISHPOND MONITORING SYSTEM

In Aquaculture, the yields (shrimp, fish etc.) depend on the water characteristics of the aquaculture pond. For maximizing fish yields, the parameters which are to be kept at certain optimal levels in water are dissolved oxygen, temperature, salinity, turbidity, pH level, alkalinity and hardness, ammonia and nutrient levels. These parameters can vary a lot during the period of a day and can rapidly change depending on the external environmental conditions

In early years, considerable amount of work has been carried out with respect to related issues yet communications with the outside world are still not completely investigated. Till now they have not ended up boundless and utilized within the different applications in which they can give huge profits. Till now they have not yet ended up boundless and utilized within the different applications in which they can give huge profits. What's more, there are still just a set number of business WSN-based results accessible in the business. This is not amazing given the difficulties identified with their configuration and execution, power utilization demands of the sensor nodes, communication failures, environmental influence, and scalability issues.

Aqua-cultured fish is one of the dominant export products in INDIA. The development of this sector is a major source of foreign currency and employment opportunity. Shrimps are one of the major varieties exported. The giant tiger prawn is the dominant species chosen for aquaculture, followed by the Indian white prawn. Shrimp production from coastal aquaculture during 2004 stood at approximately 120,000 tones. Farmed shrimp accounted for about 60% of shrimp exported from the country

II. LITERATURAL REVIEW

In Amudha, K, Nelson Kennedy Babu, C & Balu, S (2017) the SRC algorithm will be combined the Serpent and RC6 algorithms to obtain security/performance tradeoff and fastest algorithm. it is compact, speed, simplicity and easy to understand. It adapts key dependent permutation and combines different algebraic group which is adapted from RC6 algorithm [11].

In Amudha, K, Nelson Kennedy Babu, C & Balu, S (2016) The most goal of invisible watermarking is to cover a message in some audio or video information. In general, digital video was hold and processed in an encoded format for protection. During this method, information in encrypted domain while not secret writing information hide, maintain the confidentiality of the content [12].

In Amudha, K, Nelson Kennedy Babu, C & Balu, S (2016) Image partitioning technique divides the image into two parts then secret information is embedded into LSB bits. This image compression and partitioning technique improves the information embedding capacity level and hash output confirms the image integrity level [13].

In Manivanan (2009), the study of fish behavior is being applied to water quality monitoring and toxicity identification. The rapid behavioral responses seen in fish make them ideal subjects for observation, and analysis of fish behavior has been a popular approach to detect changes in the aquatic environment. When the environment is negatively affected, fish display variations in behavior such as avoidance reactions and changes in swimming ability[5].

In *Sung, W* (2014), the physical parameters of the water,temperature,ph,dissolved oxygen, active microorganism, etc., provides each fish with a suitable growth environment. Fish farm water is inherently unstable. The survival and growth of aquatic organisms are critically dependent upon the water quality. Drastic changes in water.[9]

III. BASIC PRINCIPLE

The Smart Fishpond Monitoring System is based on people's needs for fish pond aquaculture, the key water quality parameters in the aquaculture process will be sampled and controlled in real-time by all kinds of sensors acquisition. Firstly, the sensors are needed to sample water quality parameters, including temperature, water level, PH and dissolved oxygen, etc., which are processed through the signal conditioning circuit and are input to Arduino nano board (microcontroller), so as to convert analog to digital quantity. Secondly the converted results will be sent to the cloud database via a ESP8266 wireless module, and then an alert message is transmitted to the end user’s mobile phone in the time of emergency (i.e., if there is an sudden increase in the values of the parameters)

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IV. PROBLEM STATEMENT

The biggest problems for most ponds are leaf debris and a proliferation of algae. The water gets decayed if the vegetation falls into the pond. The process of decay uses the oxygen in the water and releases carbon dioxide. This means that if large qualities of vegetation enter your pond then enough oxygen can be removed to cause the ponds wildlife to suffocate. Algae is also caused by decaying vegetation, the reason for this is the nitrogen which is released during the decay process is soluble in the pond water. Nitrogen is a nutrient that is essential for plant growth and if there is a lot of it the water then it will normally result in algae bloom. Too much algae or sediment in lakes and streams can make them unsuitable for recreation and aquatic life.

pH is measured mathematically by, the negative logarithm of hydrogen ions concentration. The pH of natural waters is greatly influenced by the concentration of carbon dioxide which is an acidic gas. pH is a measure of whether water is acidic or basic. High or low pH can cause stress to fish and prevents it from reproduction. pH refers to the hydrogen ion concentration or how acidic or basic as water is and pH is defined as –log[H+]. pH value range from 0-14; pH 7 is neutral, pH<7 is acidic, and pH>7 is basic. Very high pH (greater than 9.5) or very low pH (lower than 4.5) values are unsuitable for most aquatic organisms.Aquatic organisms are extremely sensitive to pH levels below 5 and may die at these low pH values. High pH levels (9-14) can harm fish due to the fact that ammonia will turn to toxic ammonia at high pH (>9).

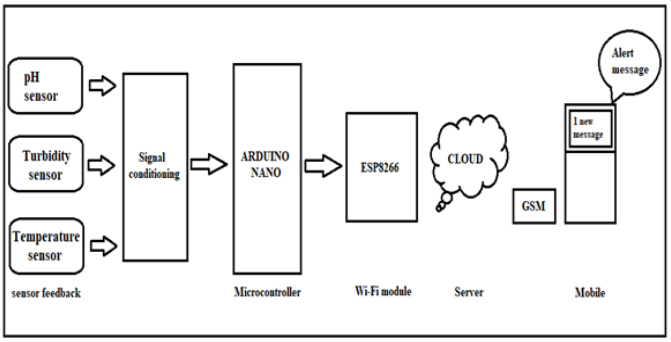
Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky. High turbidity can significantly reduce the aesthetic quality of lakes and streams, having a harmful impact on recreation and tourism. It can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function. Low turbidity values indicate high water clarity; high values indicate low water clarity. Ability of water to transmit the light that restricts light penetration and limit photosynthesis is termed as turbidity and is the resultant effect of several factors such as suspended clay particles, dispersion of plankton organisms, particulate organic matters and also the pigments caused by the decomposition of organic matter.

V PROPOSED SYSTEM

The demand for fish and fishery products are increasing considerably, both at domestic and export front. This has been caused due to the health concerns and perception of fish as a healthy food with high levels of digestive protein, PUFA and cholesterol lowering capabilities. India is the third largest producer of fish and seventh in the shrimp aquaculture production. Fish culture is growing of fish in ponds and it is one form of aquaculture. The reason for selection of this project – "Smart Fishpond Monitoring System" is to meet the demand for fish and to increase its yield effectively.

Our intension is to establish a better, flexible, economical and easily configurable fish pond water quality monitoring system by the application of internet of things and android platform. By continuous monitoring and controlling the quality of water, the breeding production and aquatic production can be increased and thereby preventing fish kills. We can use this system for aquarium and mariculture zones. The monitoring program can be configured to store data every selected time interval in seconds

VI. BLOCK DIAGRAM



The solution is to monitor the fishpond water quality through the parameters like, pH level, turbidity level and temperature level by using sensors, which is the analog input and then signal conditioning is done to ready sensors in such a way that it meets the requirements of the next stage for further processing (mostly used for analog to digital conversion). The converted digital data are sending to the microcontroller, which is interfaced with the Wi-Fi module. The Wi-Fi module provides internet connectivity to the microcontroller. By accessing the cloud's ISP (Internet Service Provider), it helps microcontroller to send data to the cloud in Internet of Things platform. The stored values in the

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cloud can be analyzed any time by the user, also in case of any undesirable changes in the values (i.e., if the sensor values reaches the limit of the set-up values & above, it means that the user should take necessary action in order to prevent fish kills, etc.),

1.METHODOLOGY

To realize real-time data collection in a secure, robust, manageable and low-cost manner without long-distance cable connections is still a bottleneck in the development of information monitoring in aquaculture. Modern fish culture environment detection and control technology achieves high-quality, high yield, improves the basic environmental conditions and it is one of the key means to promote fish production through the integrated application of bio engineering and computer technology to make the appropriate adjustments, according to the variation of indicators, increase production, and guarantee reliable income.

A properly-controlled system will also be energy efficient since production can be optimized with respect to the various inputs. So, a sustainable development of aquaculture environmental factors of monitoring and controlling system for intensive fish farming is inevitable. pH should be tested at least once a month, preferably every two weeks to allow for detection of trends before they become a problem. Remember that because pH can vary based on time of day, testing at different times of day can yield different results even though nothing is wrong.

For this reason, testing should take place the same time of day, preferably in the afternoon. In warning system, GSM and GPRS technology have been used. In case of urgent situation alert, SMS can be passed by GSM and current information are viewed in Internet of Things platform.

Through software and hardware joint debugging, the results shows that the function of pond water quality monitoring system can be implemented and the real-time monitoring of essential water quality parameters in the process of pond aquaculture can be completed with good stability and real-time performance.

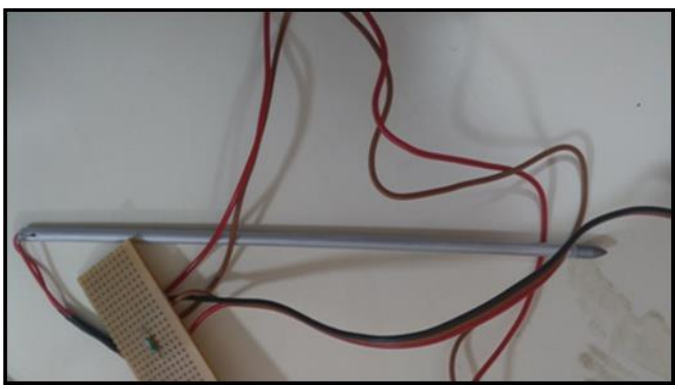
VII. EXPERIMENTAL SETUP

1.pH

Changes in the pH, especially sudden changes, can prove harmful or even fatal to fish. As the pH rises, it increases the toxicity of chemicals such as ammonia. pH changes are particularly hard on young and sick fish. In a number of species of fish, breeding occurs only within a specific pH range. Maintaining a pH in the range of 8.1 to 8.4 in marine systems will offer a natural, antiseptic effect, helping fish resist illness and also keep coral from calcifying at an accelerated speed. If the pH is in constant fluctuation, or is fixed at a position that is too high or low, it can be harmful to the organisms in your aquarium. The pH should be tested regularly to maintain ideal conditions and also to foresee any dangerous ammonia or nitrate spikes.

pH is a measure of acidity (hydrogen ions) or alkalinity of the water. It is important to maintain a stable pH at a safe range because it affects the metabolism and other physiological processes of culture organisms. It can create stress, enhance the susceptibility to disease, lower the production levels and cause poor growth and even death. Signs of sub-optimal pH are besides others increased mucus on the gill surfaces of fish, unusual swimming behavior, fin fray, harm to the eye lens as well as poor phytoplankton and zooplankton growth.

The CO_2 concentration in the water also influences the pH, e.g. an increase in CO_2 decreases the pH, as already mentioned above. As phytoplankton in the water utilizes CO_2 for photosynthesis, the pH will vary naturally throughout daylight hours. pH is generally lowest at sunrise (due to respiration and release of CO_2 during the night) and highest in the afternoon when algae utilization of CO_2 is at its greatest. Waters of moderate alkalinity are more buffered and there is a lesser degree of pH variation.



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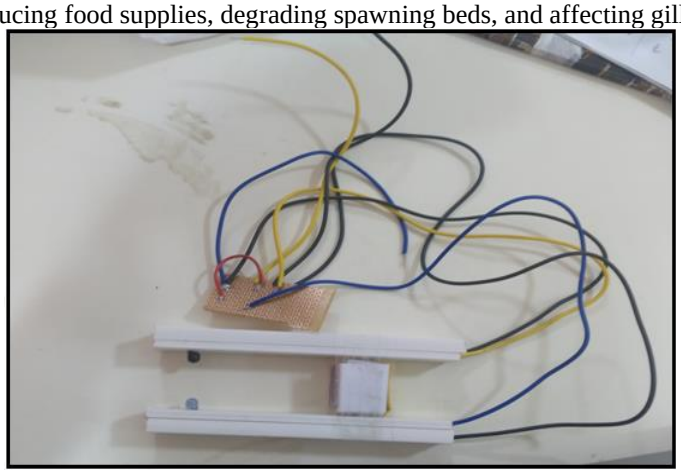
2.Turbidity

Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky. Particulate matter can include sediment especially clay and silt, fine organic and inorganic matter, soluble coloured organic compounds, algae, and other microscopic organisms.

Ability of water to transmit the light that restricts light penetration and limit photosynthesis is termed as turbidity and is the resultant effect of several factors such as suspended clay particles, dispersion of plankton organisms, particulate organic matters and also the pigments caused by the decomposition of organic matter.

High turbidity can significantly reduce the aesthetic quality of lakes and streams, having a harmful impact on recreation and tourism. It can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function.



3.Temperature

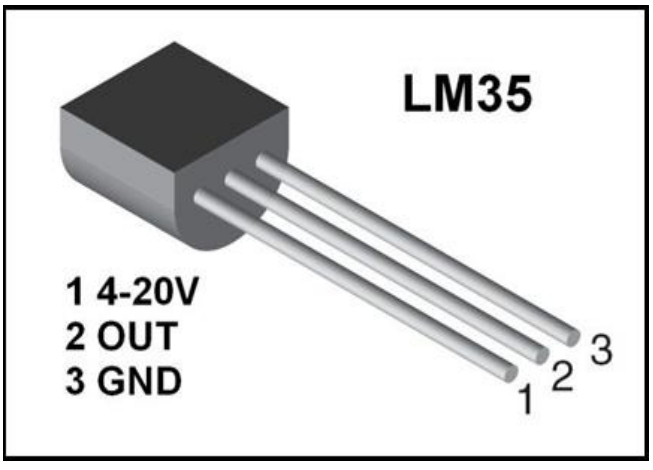
Temperature is widely known to affect development and metabolic rates in marine fish and is undoubtedly an important environmental component of early and late hatching and subsequent vital rates.It is also defined as the degree of hotness or coldness in the body of a living organism either in water or on land.

As fish is a cold blooded animal, its body temperature changes according to that of environment affecting its metabolism and physiology and ultimately affecting the production. Higher temperature increases the rate of bio-chemical activity of the micro biota, plant respiratory rate, and so increase in oxygen demand. It further cause decreased solubility of oxygen and also increased level of ammonia in water.

However, during under extended ice cover, the gases like hydrogen sulphide, carbon dioxide, methane, etc. can build up to dangerously high levels affecting fish health. It can affect fish and shrimp metabolism, feeding rates and the degree of ammonia toxicity. Temperature also has a direct impact on the biota respiration (O_2 consumption) rates and influences the solubility of O_2.

Temperature cannot obviously be controlled in a pond. Aquatic animals modify their body temperature to the environment and are sensitive to rapid temperature variations.

It is therefore important to adapt fish and shrimp progressively when transferring them from tank to pond. Also, the O_2 cycle and thus, the DO levels can be affected by changes in the environment; a cloudy day will diminish the photosynthetic O_2 input to DO. Correspondingly, uncommonly high temperatures will decrease the solubility of O_2 in water and hence lower DO. When a pond is in equilibrium DO will not change drastically.



VIII EXPERIMENTAL PROCEDURE

We have to realize real-time data collection in a secure, robust, manageable and low-cost manner without long-distance cable connections is still a bottleneck in the development of information monitoring in fish culture. Modern aquaculture environment detection and control technology achieves high-quality, high yield, improves the basic environmental conditions and is one of the key means to promote fish production through the integrated application of bio engineering and computer technology to make the appropriate adjustments, according to the variation of indicators, increase production, and guarantee reliable income. A properly-controlled system will also be energy efficient since production can be optimized with respect to the various inputs. So a sustainable development of aquaculture environmental factors monitoring and control system for intensive fish farming is inevitable.

IX CONCLUSION

Through software and hardware joint debugging, the results show that the function of pond water quality monitoring system is implemented, and the real-time monitoring of important water quality parameters in the process of pond aquaculture is completed, and is of good stability and real-time performance. Wireless technology in internet of thing (IoT) platform is applied in this system which can realize distributed complex environment monitoring requirements and has a broad market prospects. By utilizing Internet of Things, the larger part of farmers knew about the checking and cautioning discovery strategy in aqua business. This will encourage the "Smart Fishpond Monitoring System" to survey the execution of the ranchers doing freely. It empowers to give the ready messages and factual overview answer to the ranchers by regardless of area.

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