# Use of IOT-Based Aquaculture Equipment in India

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**Abstract**

Aquaculture has been considered to be the backward area within applied science and so the application of the IoT will be fruitful in making an accurate increase in the facilities. As a result, it's important to use technologies to help identify the problems which are present throughout this region, as opposed towards other sectors including farming. Very slow latency time in the provision of water cleanliness and indeed the consequent consumption of resources including water through farming are examples of challenges presented. The suggested scheme maintains a watchful eye upon that aquariums that utilises aquarium sewage for produce plants; throughout response, water that has been neutralized for acidity & ammonium by hydrogen granules inside the garden bed return to the tank. This report focuses on the facilities that are being offered by the IoT framework for increasing the quality of water for facilitating better aquaculture within India.

Through a secondary approach, the uses for this IoT equipment are highlighted for increasing the water quality in the future for enhancing India's fish cultivation. Also, recommendations are developed for increasing the benefits in the future through the deployment of AI for increasing the capability of understanding the water behavior.

**Keywords:** *Aquaculture, IoTs, flexibility, cloud computing, pollution, alerts, monitoring.*

## Introduction

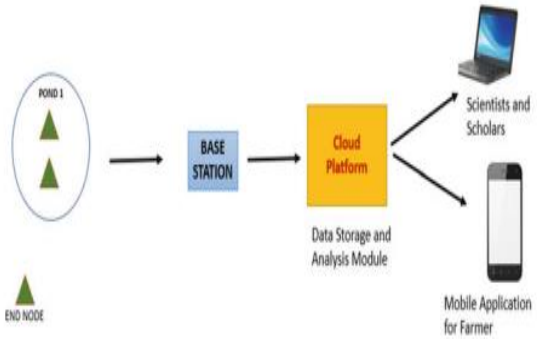
With the significant increase in technological advancements, there has been a massive increase in the facilities that will help in getting aware of the environmental conditions more accurately. Moreover, the implementation of IoT devices have been fruitful in tracking the presence of objects and help in making aware through detection. Through IoT devices, the concept of automation has helped in making automatic responses through the implementation of sensors for tracking the displacement or modification made in the external bodies. This report will focus on the usage for "IoT-based aquaculture equipment" in India that will highlight the usage purpose, facilities and benefits that are faced in understanding the water quality. Aquaculture seems to be the collection of procedures, knowledge, and methods used to raise some aquatic vegetation and animal species. Such practice is extremely important for both financial expansion and food development. The research will focus on the automation concept through the usage of IoT for determining the water quality in terms of water characteristics. Based on this aspect, the estimation is made for suitable methods that will highlight the usage of this technology in India for increasing food production and fisheries.

## Review of literature

### Protection against water pollution through IoT-based equipment

According to Shareef 2020, along with farming, aquaculture is amongst the most desired careers for those living within India's coastlines. Many farmers rely upon that income provided by aquaculture cultivation to make a living. But as a result of numerous social and ecological variables, the fresh water within those farms disintegrates and causes premature fish deaths. Farmers suffer significant large losses in this circumstance. These farmers use time-consuming, ineffective traditional methods to measure the water's overall quality. People aren't able to receive sufficient alerts and intervene to prevent the fish from deteriorating. For this purpose, the efforts have been made for the development of the architecture of an IoT framework that will help aquaculture farms in measuring the quality of the water and thereby alerting the farmers for taking necessary precautions for avoiding the losses through fish deaths. This is very evident that due to the excessive increase in the pollution level of water through the increase in the industrial discharge and human disposals, there has been a considerable rise in the water features. The changes are observed with pH, temperature, salinity, color and conductivity. So, this turns out to be a requirement for understanding the changes occurring in the water quality through the implementation of IoT sensors that will monitor these features.

**Figure 1: IoT based equipment for monitoring aquaculture**




(Source: Shareef, 2020)

The above figure shows that through the application of the IoT framework, the water monitoring facility could be accomplished that will help the farmers to visualize the water quality by clicking on the smartphone application.

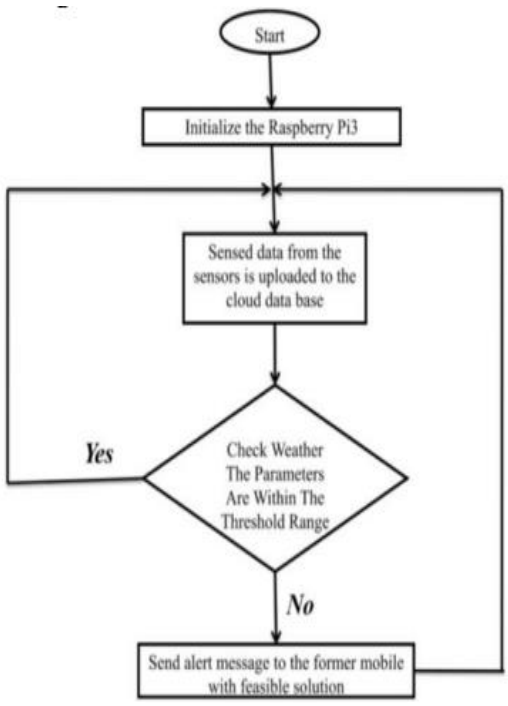
**Smart Aquaculture prospects**

According to Das 2022, due to the gradual increase in the density and scale of aquaculture facilities there has been generation of an unbalanced nature within the water environment for contemporary aquaculture over production. As a result of which there has been a considerable decrease in the quality of aquatic products with an enhancement in disease outbreak within fishes. For this purpose, the attempt is made for a smartfish form for enhancing the oxygen level, decreasing disease impedances, optimizing feeding and generating an attempt in making a replacement from human to machine for managing the fish production (Bachtiar et al., 2022). This could be accomplished by the formation of model integration through cloud best aquaculture control and monitoring systems. Through this technique there will be implementation of a smart sensor that will help in monitoring the water status and thereby will generate values for dissolved oxygen hydrogen potential, level and temperature. [Referred to Appendix 1]

**Facilities of IoT-based aquaculture**

According to Preetham 2019, water quality is generally considered to be a plain aspect that mostly depends on various parameters like carbonates, nitrates, turbidity, dissolved oxygen, temperature and pH. So, the efforts are considered through the implementation of IoT for monitoring the quality of water by visualizing the parameters through sensors in order to generate alerts to farmers through mobile applications. Based on the alert, the actions will be taken for increasing the productivity and reducing the fish loss impact.

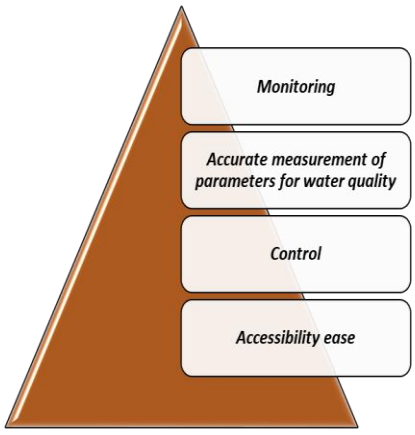
**Figure 2: Flowchart for alert generation through IoT sensors**




(Source: Preetham, 2019)

Looking at the above figure, the facilities that are being provided through the development of IoT-based equipment are as follows:

**Figure 3: Facilities**




(Source: MS-Word)

- Monitoring: Through the implementation of this model, there will be accurate monitoring of water quality by taking the data from the sensor.

- Accurate measurement of parameters for water quality: Detailed results are achieved through the help of a sensor module that will generate alerts on temperature turbidity salt and PH to the farmers (Singh et al., 2022).

- Control: A proper control could be established in the water body by making a comparison within the threshold values and sensor data accordingly.

- Accessibility ease: Due to the presence of cloud applications, the implementation of this equipment could be done from a remote location.

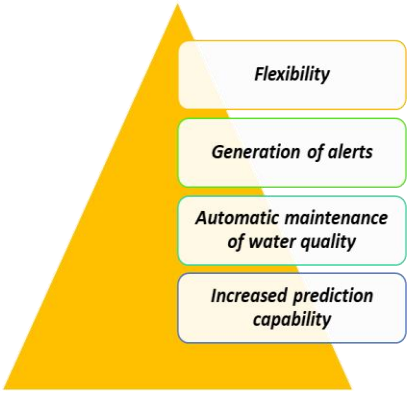
## Materials and Methodology

With reference to the research motive, there has been consideration of the secondary research that will help in performing a systematic literature review for analyzing the usage of this IoT-based equipment for enhancing aquaculture of India. There has been usage of previous research articles that helps in taking an inductive approach for making a clear explanation of the usage based on the benefits and facilities offered by this IoT framework (Gopi and Naik, 2021). Secondary data will be taken for understanding the quality of the water that needs to be verified for increasing the lifespan of fishes. Descriptive research will be made by giving a vivid description on the benefits, facilities and uses of this IoT framework and thereby suggesting quantitative data that will help make a more clarification on the use of this technology.

## Results and Discussion

Through the accomplishment of this research with secondary research, the efforts have been made for determining the usage of the IoT-based equipment for increasing the aquaculture quality in India. The categorisation of the usages are made through the consideration of the following factors of this equipment.

**Figure 4: Usage of IoT-based aquaculture equipment**




(Source: MS-Word)

- Flexibility: Through the deployment of cloud technology, this equipment will provide the facility of flexible access and thereby might allow the farmers to make remote control for upgrading the water quality parameters.

- Generation of alerts: Through the presence of sensors, there will be quick acquisition of the changes occurring in the water surface and thereby will generate data based on pH, salinity, conductivity and temperature (Yadav et al., 2023). This might generate alerts to farmers by determining the changes in the threshold values of water.

- Automatic maintenance of water quality: This equipment will help in developing efficient control within the water behavioral features that might develop impact on making a suitable comparison within the basic range of water quality.

- Increased prediction capability: Through the application of AI, there might be deployment of predictive models for testing the water features and also helping farmers for enhance the treatment quality.

**Figure 3: Desirable ranges for water quality**

| Sr. | Parameter | Acceptable range | Desirable range | Stress |
|---|---|---|---|---|
| 1 | Temperature (°C) | 15-35 | 20-30 | <12, >35 |
| 2 | pH | 7-9.5 | 6.5-9 | <4, >11 |
| 3 | Conductivity (µS/cm) | 30-5,000 | 60-2,000 | |
| 4 | Water colour | Pale to light green | Light green to light brown | Clear water, Dark green & Brown |

(Source: https://www.researchgate.net/publication/334091423_IoT_Based_Automated_Fish_Farm_Aquaculture_Monitoring_System)

The above figure the desirable limit for water quality that needs to be maintained in order to provide a safety to the fish life.

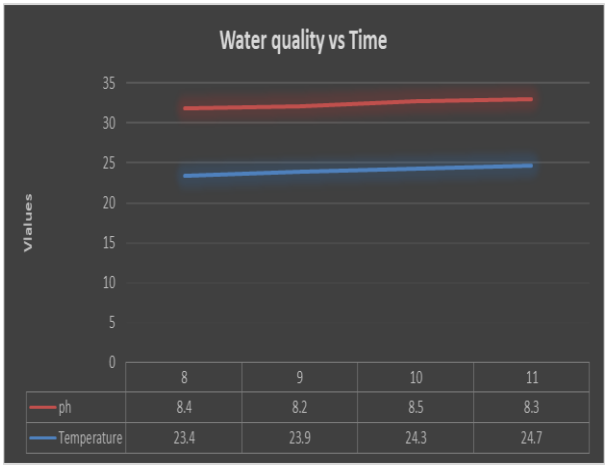
**Figure 4: Changes observed in water quality through IoT framework**

| Time | Temperature (°C) | pH | EC (µS/cm) |
|---|---|---|---|
| 08:00 am | 23.4 | 8.4 | 52.0 |
| 09:00 am | 23.9 | 8.2 | 52.3 |
| 10:00 am | 24.3 | 8.5 | 52.7 |
| 11:00 am | 24.7 | 8.3 | 53.2 |
| 12:00 am | 25.3 | 8.7 | 53.9 |
| 01:00 pm | 25.7 | 8.8 | 54.3 |
| 02:00 pm | 26.3 | 8.9 | 54.8 |
| 03:00 pm | 26.1 | 8.9 | 54.2 |
| 04:00 pm | 25.9 | 9.0 | 53.9 |
| 05:00 pm | 25.6 | 9.1 | 53.4 |

(Source: https://www.researchgate.net/publication/334091423_IoT_Based_Automated_Fish_Farm_Aquaculture_Monitoring_System)

This could be analyzed from the figure that through the deployment of this IoT equipment there will be a time-to-time review on the changes that are being observed in the quality of water and thereby helping in alerting the farmers. [Referred to Appendix 2]

**Figure 6: Water quality vs time**




(Source: MS-Excel)

**Conclusion and future scope**

To conclude, this report has helped in understanding the different utilization for the IoT-based equipment for increasing the aquaculture of India. For this aspect, the selection is made for performing a secondary research that will highlight the usages of this equipment and will focus on the benefits that are being provided to farmers in maintaining aquaculture. The effective methods are selected for performing this research that help in generating results on the different uses of this technology.

The futurescope that is developed through this research is as follows:

- This technology will help in predicting the water features through the formation of images in a remote location.
- The achievement is made in understanding the sustainability measure taken through this technology for reducing the impact of water pollution.

**Recommendations**

Based on the usages of this technique, the recommendations could be made as follows:

- In the future, there might be usage of ML algorithms that include classification algorithms for understanding the freshness of the water. This will be effective in making the farmers aware of the water type and will make suggestions for performing fish cultivation.

- In the future, based on the facilities, the efforts might be made for implementing the advanced features in Raspberry pi for increasing the flexibility of this technology.

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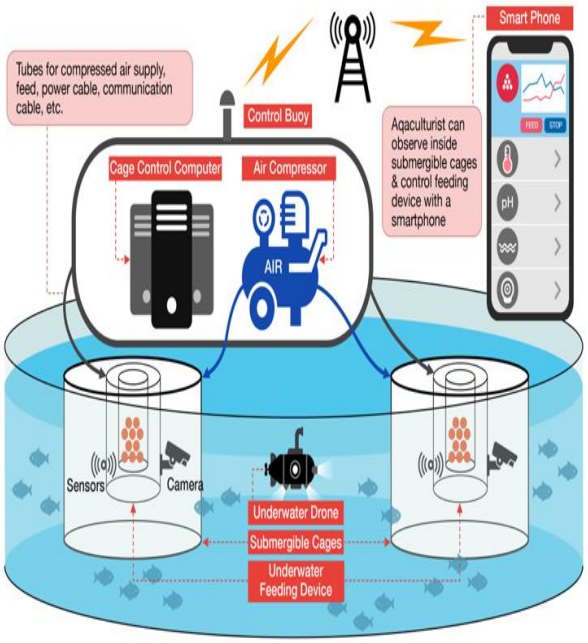
## Appendices

### Appendix 1: Smart aquaculture

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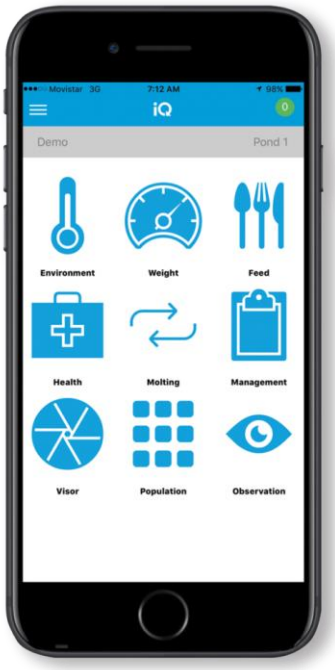
**Appendix 2: Aquaculture benefits**




(Source: https://aquaculturemag.com/wp-content/uploads/2018/06/iQShrimp_iPhone-7-1-866x1024.png)