Development of an image processing system for monitoring water quality parameters

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Abstract

The discipline of computer technology known as artificial intelligence uses a variety of speculations, models, approaches, methods, and calculations to recreate and make clever frameworks. Computer based intelligence makes it conceivable to utilize PCs to take care of issues continuously and make wise decisions. The key component for creating or resolving real-time issues is an algorithm, which is the methodical process at every turn. Aqua fauna's optimal production is solely dependent on the water's physicochemical and biological characteristics. To successfully manage pond cultures and achieve high and healthy output, one must have a thorough understanding of water quality. Their bodily processes will suffer if water quality parameters abruptly drop or rise over the ideal ranges. Therefore, maintaining high water quality is a crucial task for the survival and expansion of aquaculture output. A flexible tool for classifying the water quality is created using natural language and fuzzy logic. The unpredictable and nonlinear nature of the aqueous medium is the primary reason for designing a basic fuzzy logic system. Aqua farmers can use the established model to assess the pond water quality and stay within permitted bounds as soon as possible.

Keywords: AI algorithms, Water quality, Aqua fauna

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Introduction

AI algorithms are a collection of steps that are utilized to carry out intelligent actions and make wise decisions by utilizing perception and learning. AI's primary goal is to reduce human labor by applying technology to real-time situations. The ultimate objective is to have the user display perception behavior to an intelligent system. The most crucial step in implementing AI-based solutions or automated environments is learning. Perceiving input behaviors in many environments is one way to learn (Sun *et al.,* 2022). Building, representing, and analyzing input behaviors is done through the deep learning method, which uses neural and symbolic forms to produce knowledge. The key component of artificial intelligence (AI) that plays a key role in creating intelligent machines with decision-making abilities is knowledge representation. Deep learning requires the use of machine learning and natural language processing (Nandy and Dubey, 2024). The behaviors of input values are analyzed using machine learning algorithms. An effective intelligent AI system can read, write, process, and produce input from both native and human users. These days, the Internet plays a significant part in daily life, processing and analyzing a variety of inputs, including text, audio, video, and more (Yang *et al.,* 2022). AI researchers have created extremely efficient algorithms and computer vision approaches to handle internet requests. Expert systems were first developed for the engineering field in the 1970s, and they created computer programs via pseudocode transition. Teach the Pendent kind of AI system that is used in business and telecommunications settings for expert application processing. In this situation, learning and adapting to a new situation are challenging processes. Therefore, the decision-making process is inadequate, and it takes a long time to handle complex problems (Ahmed *et al.,* 2020). In order to make decisions using inference rule forms, expert systems were developed in the 1980s using if-else statements. At this point, the initial AI system is unable to manage chat-based apps, language processing, and real-time data processing (Yuan *et al.,* 2018).

Materials and Methods

According to the literature review, it is not required to track every water quality parameter in order to create the model because imbalances in one would have an impact on numerous interconnected factors (Yigit Avdan *et al.,* 2019). Subsequently, just the six most essential water quality boundaries temperature, pH, saltiness, complete alkali nitrogen, turbidity, and dissolved oxygen (DO) are considered for examination (Charef *et al.,* 2000). Saltiness and disintegrated oxygen show the endurance of amphibian creatures; absolute alkali nitrogen demonstrates the digestion of oceanic organic entities; temperature demonstrates the appropriateness of the sea-going climate; pH demonstrates the idea of the water medium (i.e., causticity or alkanity); and turbidity demonstrates the entrance of light energy for sea-going organic entity endurance. Hardness, Body, COD, H2S, and different boundaries are undeniably affected when there are minor physical-substance changes in temperature, pH, disintegrated oxygen, saltiness, all out alkali nitrogen, and turbidity. These six water quality

indicators were taken into consideration for the classification of pond water quality since they are the primary determinants of the variance of other water quality parameters and because they also make design simpler (Dong *et al.*, 2015). In figure 1 shows the proposed flow below.

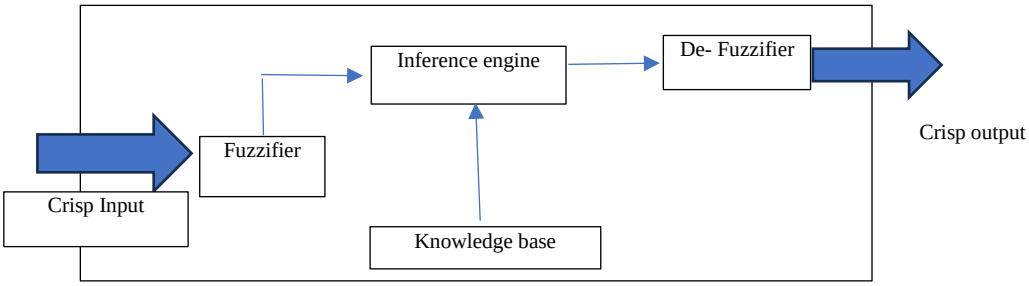

Figure 1: Proposed flow.

In figure 2, Fuzzy Inference System (FIS) is the term for fuzzy reasoning. Other names for it include fuzzy logic controller, fuzzy expert system, fuzzy model, and fuzzy associative memory. Fuzzification, Rule Evaluation, and Defuzzification are the three phases involved. A nonlinear mapping from the input space to the output space is implemented by FIS. For this mapping, several fuzzy if-then rules are used. The two key fuzzy inference methods that are employed are Mamdani and Sugeno. The Mamdani fuzzy inference methodology is the most widely utilized approach. The Mamdani process consists of four steps: defuzification, rule evaluation, aggregation of rule output, and fuzzification of input variables. The outcome is obtained by satisfying the antecedent component of each rule after the inputs have been fuzzified (Li *et al.*, 2020). To execute the fuzzy operator, at least two enrollment values from the fuzzified input factors should be available. To make a judgment in view of the guidelines of a fluffy derivation framework, the standards should be coordinated here and there. The most common way of blending each of the guidelines of fluffy sets that address the results into a solitary fluffy set is called conglomeration.

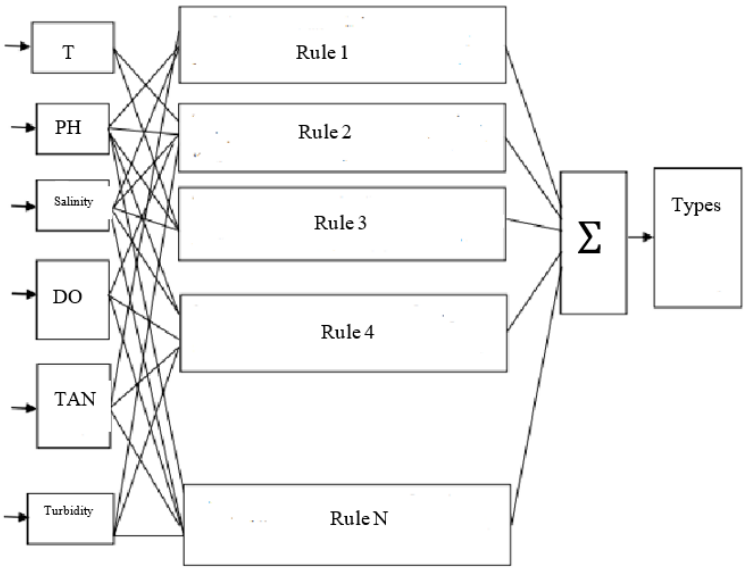

Figure 2: Fuzzy logic based aqua pond water quality assessment.

Results and Discussions

Temperature, pH, saltiness, broke down oxygen, all out alkali nitrogen, and turbidity readings were among the water quality elements considered for order. Ranchers in the Indian province of Andra Pradesh gave information from five lakes between the principal day of development and the collecting day (the 100th day). At 6.30 a.m., water tests were gathered from the lake and broke down. Succeed was utilized to classify and examine these information shows in figure 3.

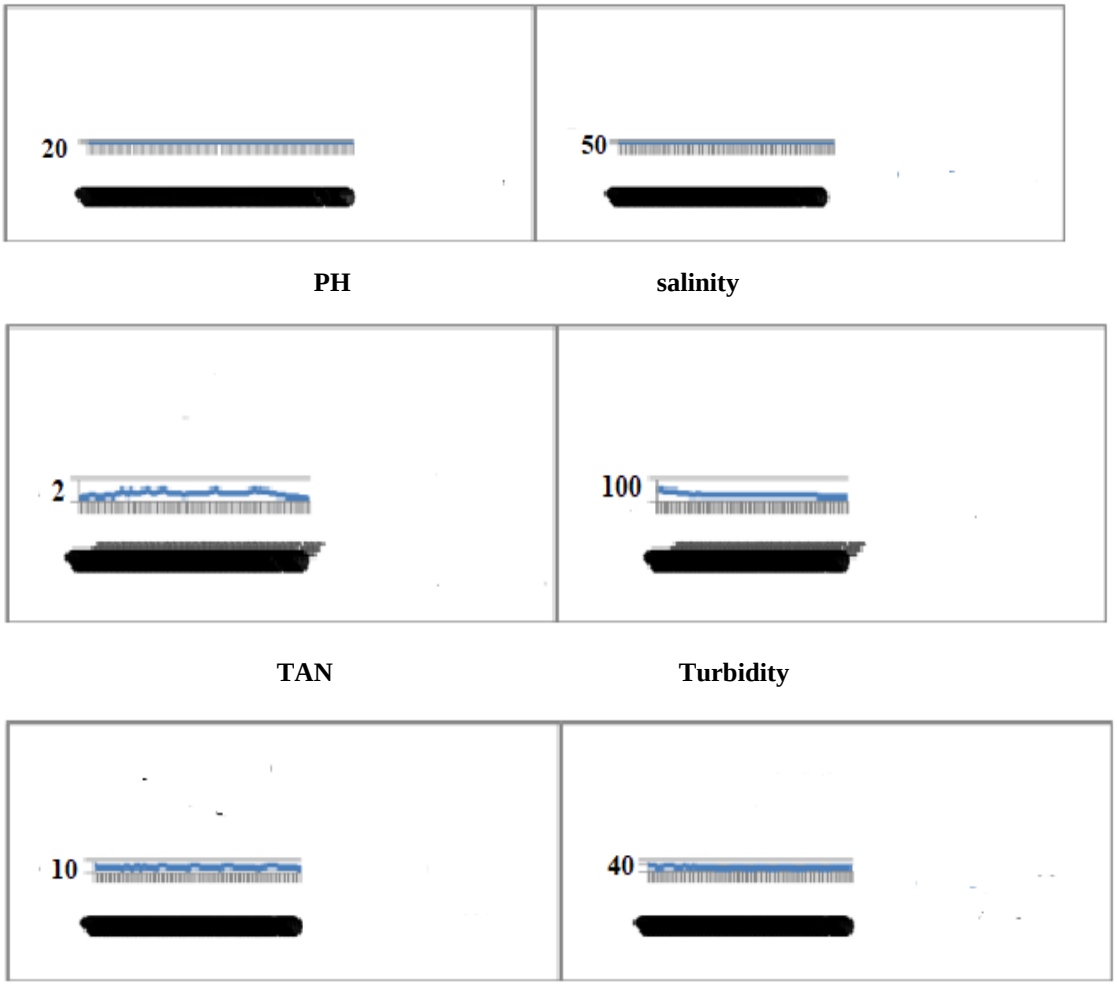

Figure 3: Daily measured lake water quality boundaries from day1 to Day 100.

The system for fuzzy inference is given a set of inputs. Fuzzy rules are used to process the measured concentrations of several factors collectively.

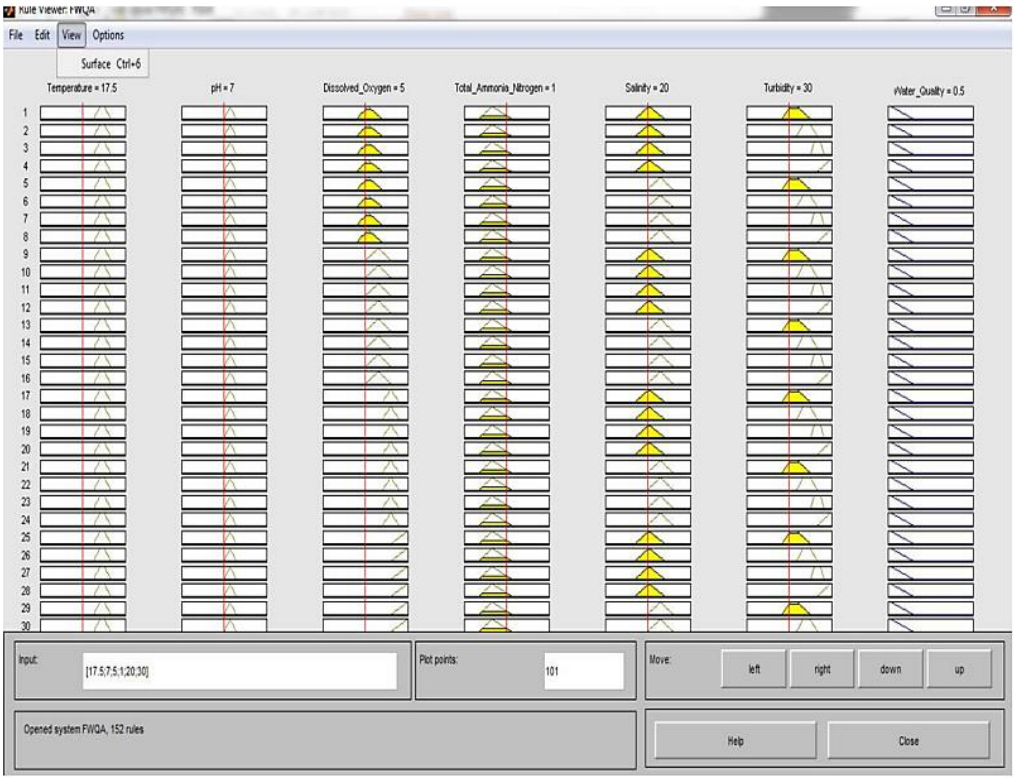

Figure 4: Fluffy rule watcher to evaluate shrimp lake water quality

74% of accurate findings are a result of the fuzzy classifier model's overall performance. In a FIS, firing a rule is difficult, and as the size of the inference rule grows, so does the time required to provide an exact result show in figure 4.

Conclusion

The control of pond water quality is crucial to the economic expansion of shrimp farmers. It is a crucial consideration since declining water quality is detrimental to shrimp growth and longevity. Additionally, it puts shrimp under environmental stress, which can hasten the development of a variety of illnesses. For optimal shrimp development and survival, pond water quality must be maintained at ideal levels every day. Officials and researchers demonstrate that the Fluffy Induction Framework's thinking in view of hydroponics models decides the lake water quality for the development of sea-going creatures or potentially vegetation. The water nature of shrimp lakes is the primary subject of this review. Utilizing six information sources and one result, this fluffy model surveys the water nature of shrimp lakes and predicts to amphibian ranchers that the lake water quality will be kept inside satisfactory limits quickly.

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