

Implementation of a Fuzzy Mamdani-Based Automatic Water Circulation System for Catfish Aquaculture

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ABSTRACT

Successful catfish aquaculture heavily relies on maintaining water quality, which directly dictates the health and growth dynamics of the fish. To optimize this, this research engineers and deploys an automated water circulation system using the Fuzzy Mamdani method for real time monitoring and regulation. The system evaluates three pivotal parameters, namely acidity pH, temperature, and turbidity, utilizing pH 4502C, DS18B20, and turbidity sensors. Data streams are processed by an ESP32 microcontroller executing a fuzzy logic algorithm to classify water safety into four categories, which are optimal, adequate, poor, and critical. Control decisions for pump operation are formulated using 27 predefined rules that combine all input variables. Meanwhile, defuzzification is executed via the Center of Area technique to produce a crisp output value. Experimental results demonstrate the platform capability to capture water quality fluctuations precisely and trigger appropriate responses, including circulation, partial water replacement, and full drainage. Performance validation indicates stable sensor readouts and precise actuator responses aligning with system directives. Furthermore, a web based monitoring platform streamlines the remote supervision of live system statuses. In conclusion, this innovation successfully maintains catfish pond environments autonomously while significantly improving operational efficiency in aquaculture management.

Keywords: Fuzzy Mamdani, Internet of Things (IoT), Water Quality.