ABSTRACT

FIELD INSTRUMENT CALIBRATION DECISION THROUGH ANOMALY-DRIFT DETECTION AGGREGATION AND DISTRIBUTED CONSENSUS MECHANISM VALIDATION METHOD

by

M. Fithroh Fajar RSH
20/457754/PA/19792

Calibration is crucial for industrial success, ensuring the accuracy and consistency of measuring instruments used in production. Delays in the maintenance process or non-calibration of a problematic field instrument can lead to potentially catastrophic consequences. This problem is further exacerbated by reliance on manual (offline) calibration methods and the lack of automated maintenance notification systems based on anomaly detection in field instruments.

This paper proposes a calibration decision system utilizing artificial intelligence (AI) technology. The system aggregates multiple anomaly detection models into a consensus mechanism that produces validated and verified data integrity for each instrument variable. A miniature model prototype was designed with research variables of flow, pressure, and level in a circulating water system. Anomaly detection was generated through sensor interference testing.

A 9-hour simulation produced 539 timestamps of data from the collection phase. Out of 62 sensor disturbance experiments on the research variables, the intelligent system model correctly detected 37 times (True) and 25 times incorrectly (False). This results in a system accuracy of 59.7% and a False rate of 40.3%. Level disturbance testing detected anomalies by all anomaly detection models: Long Short Term Memory Anomaly Detection (75 anomalies), Local Outlier Factor (6), Isolation Forest (6), Flow Regression (132), Pressure Regression (129), Intake Level (131), and Discharge Level (131).

The results of the aggregation model detected 135 anomalies and 237 normal operations. In conclusions, the intelligent anomaly detection system developed for the instrument model prototype successfully identified anomalies introduced through simulated disruptions to each sensor or research variable. However, the achieved accuracy of the anomaly detection system remains low, indicating a need for further refinement.

***Keywords**:* Field Instrument, Calibration Decision, Anomaly Detection, Consensus Mechanism, Aggregation