

# Centralized Weld Data Monitoring System for Quality control and Productivity in Shipyards Using AI & ML

## Abstract

Welding is a fundamental process in shipbuilding, where structural integrity and quality assurance are critical to safety and regulatory compliance. Traditional defect detection methods rely on manual inspections and post-weld quality checks, often leading to costly rework, production delays, and increased material waste. This study proposes a Centralized Weld Data Monitoring System that integrates multiple IoT-enabled sensors, Artificial Intelligence (AI), and Machine Learning (ML) to enable real-time welding parameter monitoring, welder performance tracking, welding machine health monitoring, and predictive defect prevention in shipyards.

The system continuously collects data from sensors measuring welding current, voltage, arc stability, wire feed speed, gas flow rate, heat input, and torch position. AI and ML algorithms analyze this data to detect anomalies and predict potential defects such as porosity, cracks, undercuts, and lack of fusion before they occur. Additionally, welder performance is monitored through tracking of torch angle, travel speed, arc-on time, and consistency in heat input, providing real-time feedback to improve precision and efficiency.

For welding machine monitoring, the system utilizes sensors to track motor performance, electrode condition, cooling efficiency, gas supply, and mechanical vibrations. By leveraging AI-driven predictive maintenance, potential equipment failures are anticipated, reducing downtime and ensuring seamless welding operations.

By implementing predictive defect analysis, this system minimizes welding errors, improves productivity, enhances safety, and ensures compliance with shipbuilding standards. The study discusses the system architecture, AI/ML integration, benefits, challenges, and future advancements in smart welding defect prevention for shipyards.