

INNOVATIVE IoT MODULE FOR PRECISION WEIGHT MONITORING IN MANUFACTURING PROCESSES

By

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

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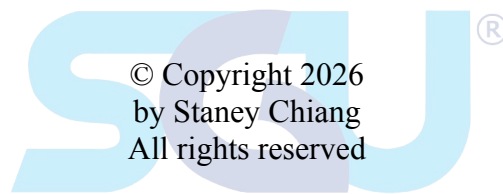
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In modern manufacturing, the reliance on manual documentation for material inventory leads to delayed data acquisition and unoptimized production cycles. This thesis presents the development of an economically viable, Internet of Things weighing module designed to replace manual supervision. The hardware architecture utilizes an ESP32 microcontroller integrated with an HX711 24-bit ADC Converter and a single-point load cell. To ensure the reliability, the C++ firmware utilizes an autonomous creep compensation and a digital Exponential Moving Average filter to lock weight readings caused by environmental factors. Telemetry is transmitted via a TLS-encrypted MQTT protocol to a HiveMQ cloud broker, achieving an average network latency of 175 milliseconds. A cross-platform Human-Machine Interface was developed using Python and Streamlit, featuring a remote Wi-Fi provisioning system with an automated CSV data exporting for auditing. Furthermore, the cloud backend deploys a time-series linear regression algorithm to provide supply chain managers with an estimated time to empty forecast to enable Just-In-Time material replenishment. Experimental validation demonstrated a maximum static load error of 1.49% and a negligible 0.8g deviation under eccentric loading conditions.

Keywords: *Internet of Things, MQTT Telemetry, Machine Learning, Just-In-Time Manufacturing, ESP32, Streamlit.*



DEDICATION

I dedicate this work to Maria Georgina Wibisono, my family, and friends.



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