Real-Time Agricultural Yield Weight Monitoring System Using Load Cell Sensor Based on Internet of Things in Electric Wheelbarrow

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ABSTRACT

Traditional post-harvest workflows require farmers to execute repetitive tasks, where harvested commodities must be transported from fields to roadsides, accumulated, and weighed separately using conventional scales. This disjointed process is highly inefficient, wasting significant time and human labor. This research aims to integrate a load cell sensor-based weighing instrumentation system directly into an electric wheelbarrow transport vehicle integrated with the ThingSpeak Internet of Things (IoT) platform. Through this implementation, both transportation and mass measurement can be executed simultaneously (one-stop operation). The central system utilizes an ESP32 microcontroller to process 24-bit digital data from two HX711 ADC modules that separate front and rear chassis readings to compensate for initial mechanical imbalance. The weight data is visualized in real-time on a TFT LCD screen and transmitted wirelessly to the ThingSpeak cloud server. Centralized weight precision evaluation was tested using variations from 30,30 Kg *to 201* Kg*. Based on statistical analysis, the system exhibits outstanding reliability, achieving a Mean Absolute Percentage Error (MAPE) of 0,50%. In the cross-load distribution test (4* Kg*), the largest deviation occurred at the behind-left corner with a 2,75% error due to the mechanical torque on the chassis frame. However, evenly distributed loads activate a cross-compensation effect among sensors, where the higher sensitivity on the right side offsets the slight underreading on the left side, perfectly sustaining total reading accuracy. The local logging system powered by the DS3231 RTC and MicroSD memory proved reliable as a fail-safe data storage mechanism, saving harvest records in .csv format when the vehicle navigates agricultural fields isolated from cellular networks (blank spots). Concurrently, the IoT telemetry transmission operates highly stably with network latency (delay) constantly ranging between 2 to 4 seconds.*

Keywords**:** *Electric Wheelbarrow, Load Cell,* ESP32*, ThingSpeak, Smart Farming.*