Pragmatic Semiconductor

Flexible intelligence

Automatic egg breakage detection solution

February 2026

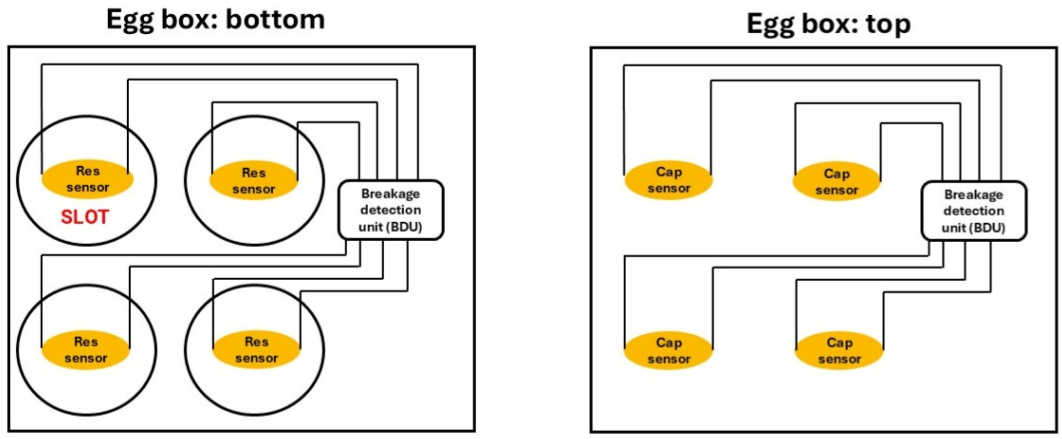
© Pragmatic Semiconductor

Automatic egg breakage detection solution

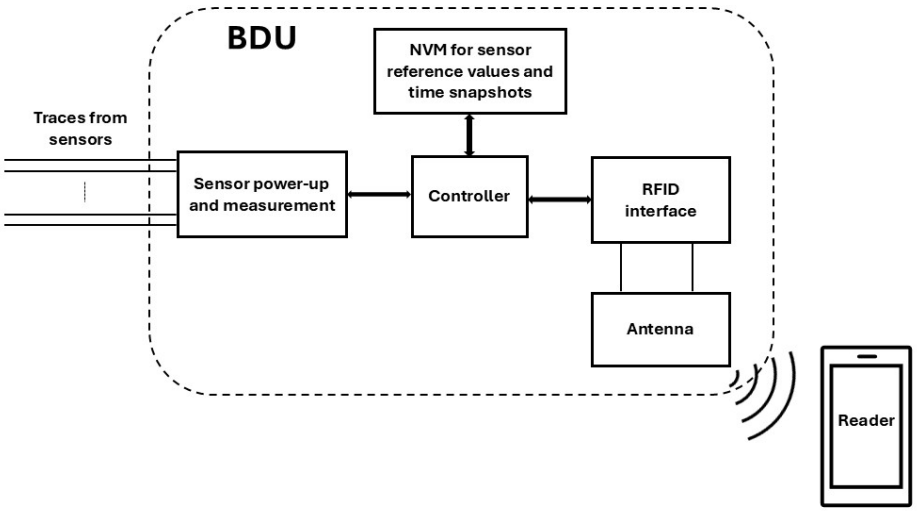
Eggs are among the most transported foods in the world, but they are also one of the most fragile. Early detection of breakages can reduce food waste and contamination, enhance producer/retailer reputation, and improve customer satisfaction.

Currently, there is no smart functionality built into egg boxes to enable early breakage detection during bulk transit. We propose a solution based on low-cost, low-carbon FlexICs – ultra-thin, physically flexible chips.

Breakage detection solution: overview



Breakage detection unit (BDU)



Confidential - Copyright © Pragmatic Semiconductor Limited 2026. All rights reserved.

The controller block is the ‘brain’ of the breakage detection unit (BDU).
When the reader powers the egg box through the RFID interface for the first time, the controller starts the first-time boot sequence by reading all the sensor data, and writes these values into the non-volatile memory (NVM), which will be used as a reference.

This is done by the sensor power-up and measurement block that generates the current/voltage to power up sensors, reading the voltage levels and converting them to digital data. This sequence is initiated once when the egg box is filled up with eggs. Once the first-time boot sequence is complete, the egg box is ready to be shipped. (Note: There may be cases when this sequence can also be initiated when the egg box is empty.)

The time when all eggs are good is also recorded in the NVM. The time data is captured by reading the time from the real-time clock from the reader but, if the BDU is powered by a battery, can be equipped with an on-chip real-time clock.

After transportation, when the reader powers up the FlexIC, the controller initiates the breakage sequence by powering up the sensors and reading the sensor values. They are then compared to the sensor values stored in the NVM as a reference. The comparison can be exact or approximate – meaning that the values must exactly match the reference values or match the reference values with a pre-determined tolerance. In the latter case, the breakage is a prediction.

Once an egg breakage is detected, the last time when all eggs were good is read from the NVM and is compared to the time when the egg breakage is detected. The controller can also predict whether the entire box is comprised and/or contaminated and should be discarded for health and safety reasons.

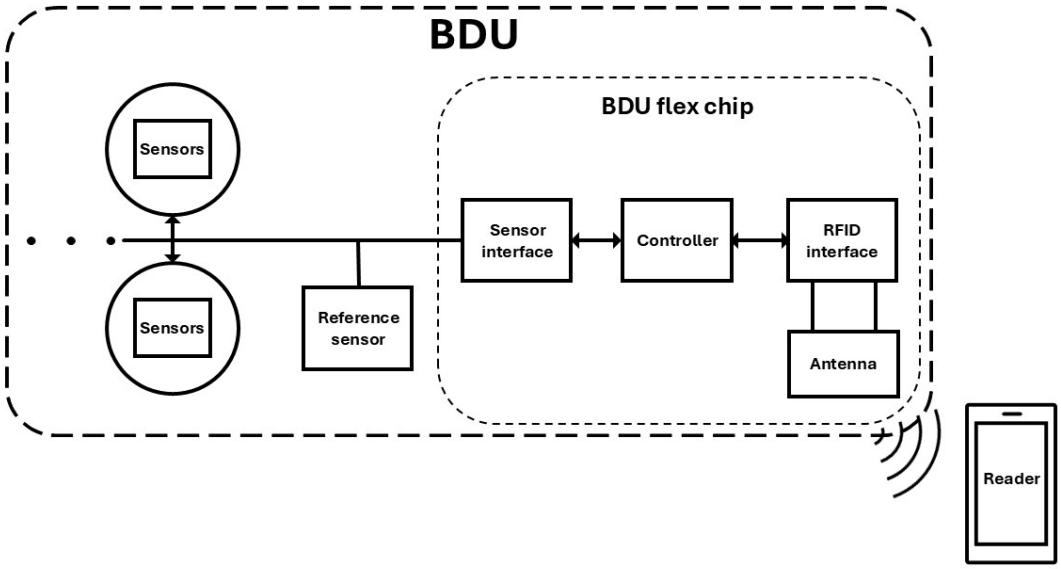
Reference-sensor-based solution

As an alternative solution to prevent the requirement for initial measurements during the packaging phase, we propose using reference sensors located close to the FlexIC.
Each time the chip is powered (e.g., by the RFID reader), it compares the values from the reference sensors with the sensors allocated on the bottom and top of the eggs. If the difference is within the process variation range, this indicates that there is no crack or damage in the eggs.

This method eliminates the need for an initial setup phase where the system would normally take and store baseline measurements when the eggs are first placed in the box. Instead, by using the reference sensors, the system can immediately compare the sensor readings from the egg slots to the reference sensors each time it is powered on, simplifying the process while still ensuring the integrity of the eggs in the box.

The following diagram shows the alternative system with the reference sensors placed near the BDU.

Confidential - Copyright © Pragmatic Semiconductor Limited 2026. All rights reserved.



About Pragmatic Semiconductor

We’re doing semiconductors differently – making them flexible, sustainable, and at speed and scale.
Our ultra-thin chips bring intelligence to the extreme edge and empower innovators with dramatic design miniaturisation – all in an industry-leading carbon footprint. Our groundbreaking modular production delivers rapid fabrication and a resilient new pathway for the global semiconductor supply chain.

pragmaticsemi.com

Confidential - Copyright © Pragmatic Semiconductor Limited 2026. All rights reserved.