Monitoring Environmental Conditions in Pfizer's Pre-Clinical Supply Chain

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Story

Pfizer discovers, develops, and manufactures investigational medicines in hopes of making life changing medications available to a broad number of patients. Many research Active Pharmaceutical Ingredients (API) and drug products (e.g. tablets & capsules) have sensitivity to moisture and may require protective measures to ensure product integrity.

Compounding the issue, some research materials may have extended dwell times in a warehouse environment due to the sometimes-unpredictable nature of pharmaceutical development which can elevate risk for products.

Sensor Board in Drum → Mesh Network → Network Controller + Computer → Data Analytics
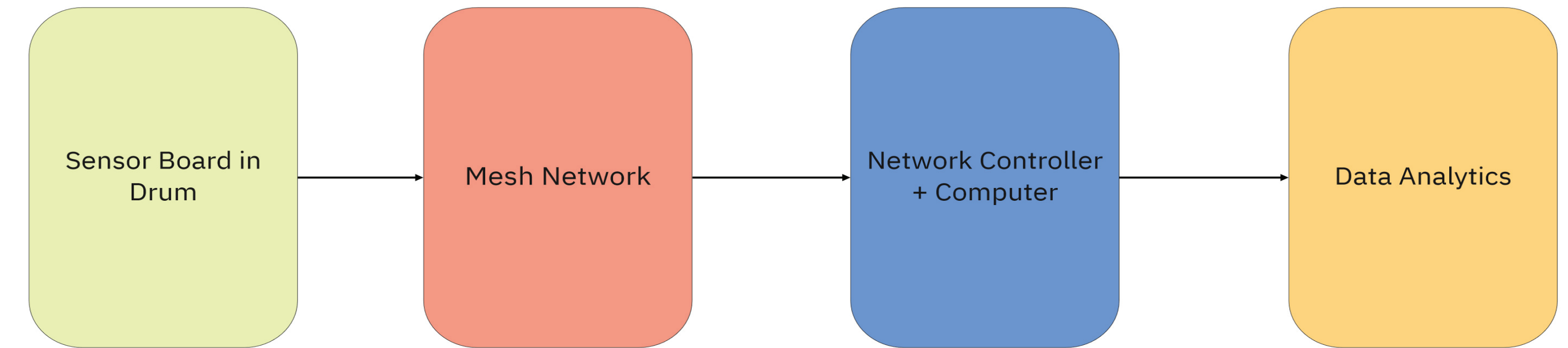
Hardware

Our custom hardware is equipped with a suite of sensors, a power conversion unit, and all of the RF components necessary for communicating over a Zigbee network

Temperature & Humidity

To ensure we could deliver high quality data that lives up to Pfizer's rigorous standards, we tested our temperature and humidity sensors against an official sensor approved by the National Institute of Standards and Technology (NIST).

A constant stream of temperature and humidity data from individual drums will allow Pfizer to closely monitor the warehouse storage environment

Temperature Calibration Curve

Humidity Calibration Curve

Sensors

Headspace Sensor Data Evaluation
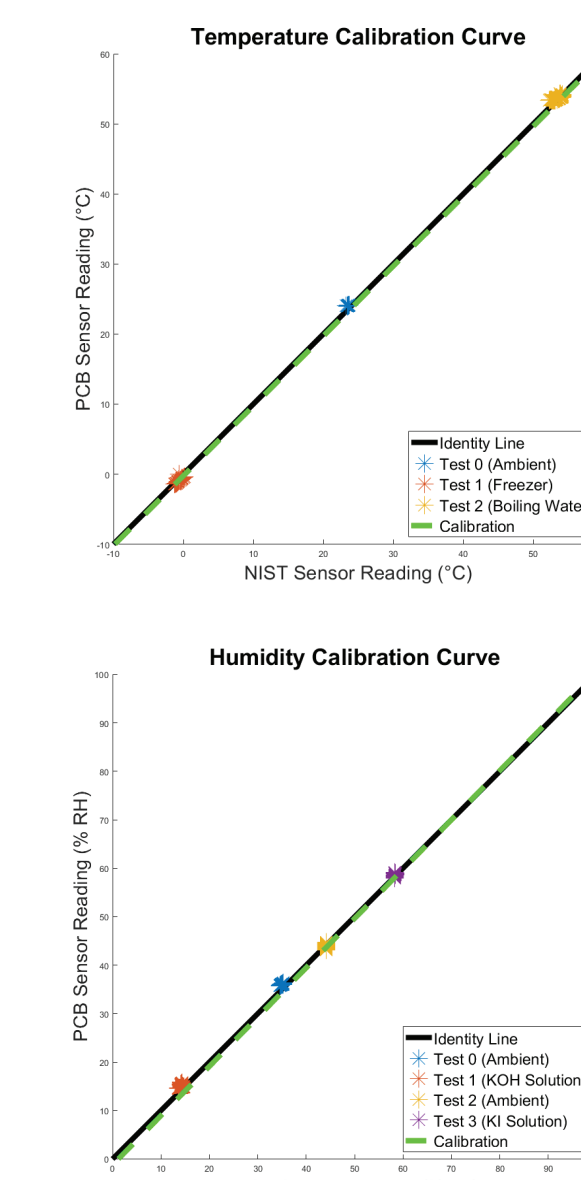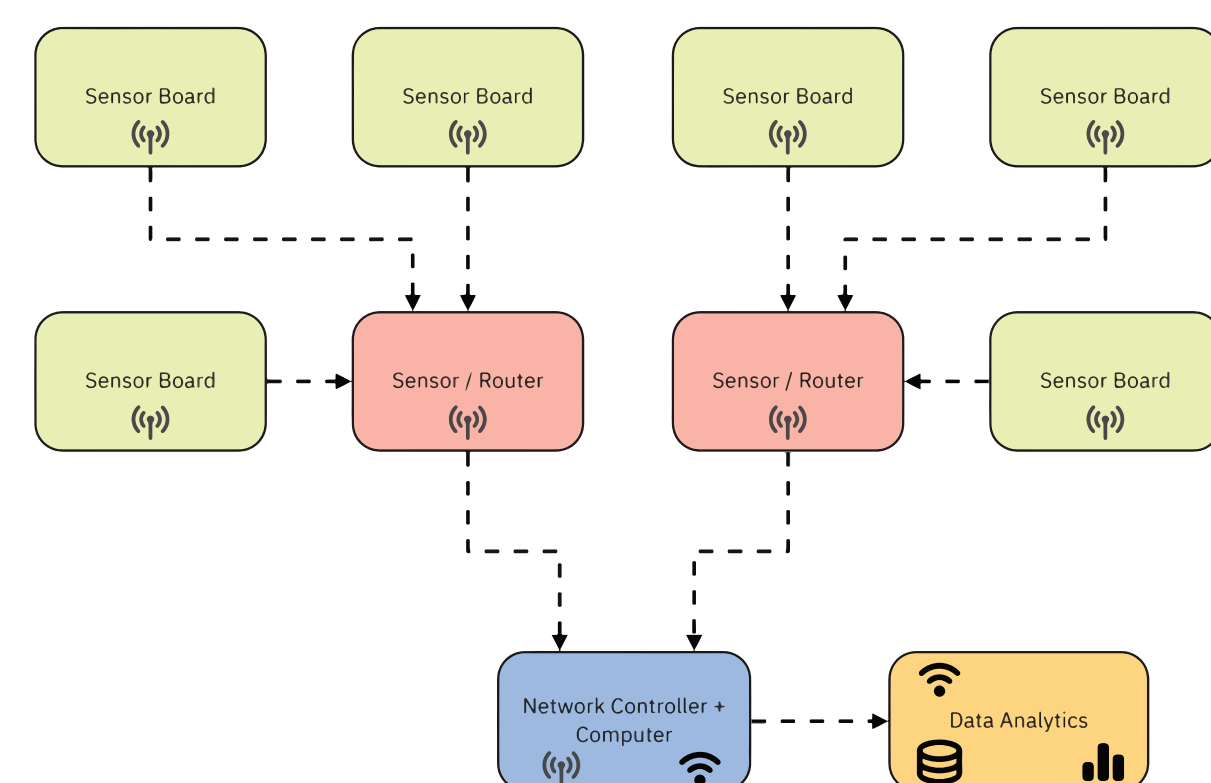
Content-Level Detection

We utilized a time-of-flight sensor to gauge the amount of material left inside a drum so that Pfizer can accurately take inventory of supplies at any time
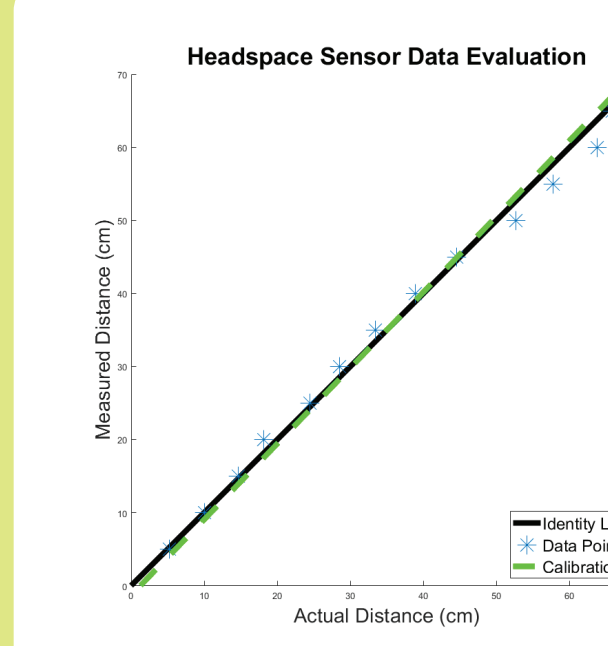
Lid-Opening Detection

We utilized an accelerometer to detect lid openings so Pfizer can monitor disturbances to individual drums

Mesh Network

We designed a network for the purpose of sending data from each sensor board to the network controller computer, which would then upload the data to the cloud. Considering that there could be hundreds of sensors within a warehouse, we believed a mesh network would be best. The mesh network is designed to have a large number of devices and send data to one central point. We created a small scale version of the mesh network using three devices to prove that data could reliably sent from the sensors to the cloud without interaction from the user.

Data Pipeline

mongoDB

Relative Humidity (by drum) vs. Time

After data is collected from our network of wireless devices, it is uploaded to a secure instance of a MongoDB database. The Spotfire visualization dashboard we configured then automatically pulls the latest data from the database to provide real-time insights to the Pfizer team.