Empowering Supply Chain Leaders with Customized Data Solutions to Support Clinical Trial Success

Olin College of Engineering SCOPE

Our Team

Student Team:
Missoury Lytle, Nathaniel Tan, Gracey Wilson, Samantha Young
Olin Adviser: Alessandra Ferzoco
Subject Matter Experts: Siddhartan Govindasamy, Bradley Minch
Pfizer Liaisons: Ted Bradley, Dana Dyer, Kersten Elenteny, Paul Gerst, Laddie Grim, Carol Miello, Nancy Morrone, Robert Timpano

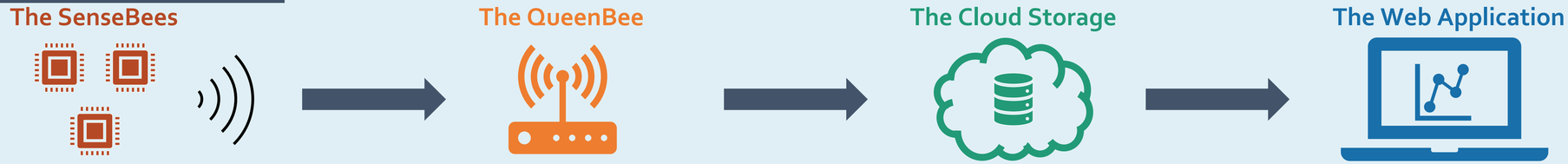
Context and Goal

Pfizer develops **life changing** medications that make the world a healthier place. In their clinical supply chain, drugs are often held in long-term storage in **individual drums**. The goal of this project is to create an **environmental sensing system** at the individual container level in the warehouse. We developed a proof-of-concept prototype demonstrating feasibility of a remote, **automated data collection** and visualization system that gives visibility into the humidity and temperature conditions of individual storage units. This allows Pfizer to proactively draw conclusions about the **risk state of drugs** in the supply chain.

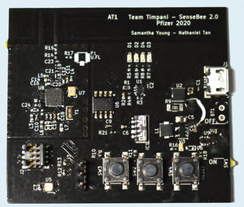
Impacts

The system is a proof-of-concept that can be implemented in Pfizer's clinical supply chain network. If taken into production, the system would allow real-time visibility into drug product humidity and temperature conditions at the drum level in all Pfizer facilities around the world, enabling Pfizer to make informed decisions about the risk state of individual containers of drugs in their supply chain while preserving resources. This strengthens the quality and efficiency of Pfizer's clinical trial supply chain, supporting the development of life changing medications for global health.

Our System: Warehouse to Employee



Collecting Data with "SenseBees"



Custom SenseBee printed circuit board

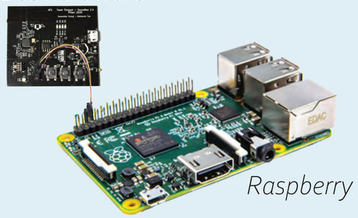
The SenseBees are custom devices equipped with sensors to collect humidity and temperature data from within individual drums. Designed to conserve power, SenseBees maintain a long battery life to match the life of a drum. Their 3D-printed enclosures have vents for air flow to ensure accurate readings and adhere to the side of the drum inside a nonshedding fabric pocket. SenseBees use a protocol called ZigBee to transmit data through a wireless mesh network. All SenseBees within range of each other can share information until the data reaches the next step: the QueenBee.

The SenseBee hardware in its 3D printed enclosure

Centralizing with the "QueenBee"

SenseBee hardware

Data transfer with I2C

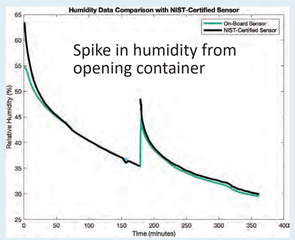


Raspberry Pi

Made of two parts, the QueenBee centralizes the SenseBee data from around the warehouse. The first part uses SenseBee hardware, receives data through the mesh network of all proximal SenseBees within drums in the warehouse. It sends collected data to the second part, a small computer called a Raspberry Pi, over a wired communication protocol called I2C. The Raspberry Pi then transmits the humidity and temperature data to cloud storage at regular intervals. After confirming that the data has been safely received in the cloud, the QueenBee deletes its copy to make space for the next round of SenseBee data.

Processing Data in the Cloud

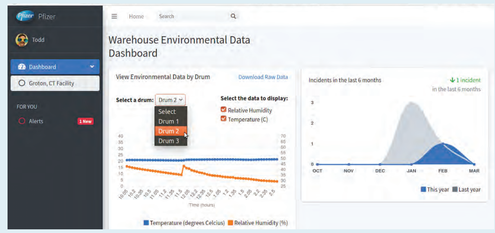
Cloud data storage serves as a centralized, offsite database to minimize physical server storage in the warehouse. It also makes the SenseBees' data accessible remotely by any Pfizer employee, rather than only those physically within distance of a particular QueenBee, an essential design constraint for scaling to Pfizer's clinical supply chain network. Cloud computing allows this global network of employees to share and receive data using only their Pfizer-issued devices and internet connection.



Calibrated data collected from SenseBee Sensor compared to NIST certified humidity sensor

We compared data from a SenseBees' humidity sensor to a NIST-certified sensor. The calibrated curve was a consistent match during design testing.

Visualizing in a Web Application



The web application is an interactive website that allows users to view specific data - like the humidity levels in a specific drum in a specific warehouse over the past week. It calls to the cloud database server and displays real time information in easily understandable graphs, allowing Pfizer employees to gain insight about the environmental conditions that any individual container of drug has experienced. Possible use cases and ways to visualize this data include comparing by drum, drug type, and location within a warehouse. Our prototype demonstrates the beginning of this potential!