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## Introduction

Over 40 million Americans suffer from pollen allergies, but detailed concentration data is not widely available.

**Goal:** Create a device that can:

- Count & classify pollen
- Transmit data to an external app

Image and count pollen particles

Run without manual intervention

Identification with 90%-95% accuracy

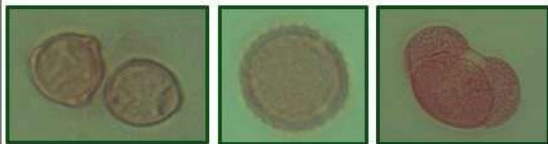


Mock-up data integration to external app

## About Pollen

**Goal:** Speciate between pollen types using:

- Particle Size Range: 10 to 100  $\mu\text{m}$
- Pollination Period: Early April until late August



*Betula occidentalis*    *Apsilostachya ambrosia*    *Pinaceae Pinus Strobus*

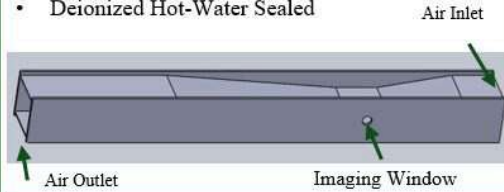
Dr Bielory's pollen dataset contains images that we can compare to the ones taken by our device.

## Design

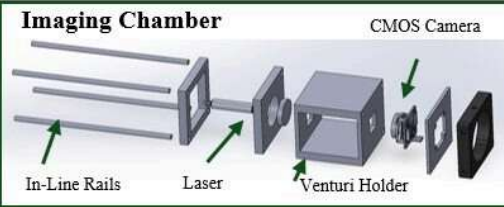


### Aluminum Air Flow Venturi

- Clear Anodized
- Deionized Hot-Water Sealed



### Imaging Chamber



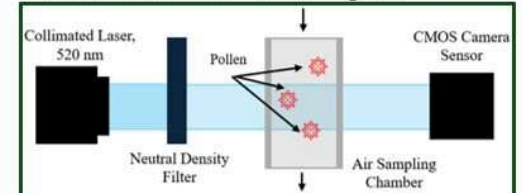
### Internal Electronics

- Raspberry Pi 5 Microcontroller
- Arduino R4 Uno Wi-Fi
- Particulate Matter Sensor - 1 to 10  $\mu\text{m}$

## Digital Holography

**Goal:** Image moving pollen with high detail

- Feature Size: 1.0 – 3.0  $\mu\text{m}$ /pixel

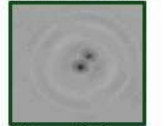


### Imaging Steps:

1. Particle passes in path of laser
2. Particle creates diffraction pattern
3. Diffraction pattern observed by CMOS sensor
4. Post-processing code:
  - Reconstruct & subtract background noise

### Technology Benefits:

- Image over depth
  - Changing focal plane
- Imaging moving particles
- Low-cost, minimal components



Holographic image, pollen in flow

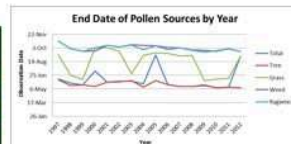
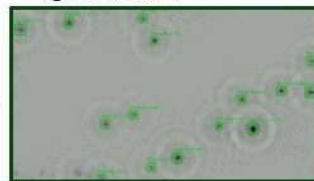
## AI Model

### Counting

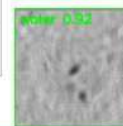
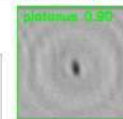
- YOLO: You Only Look Once – no particle tracking
- Output pollen concentration (grains/ $\text{cm}^3$ )

### Speciation

- Differentiate between species using shape, features, time, size, & location



from Maryland Department of Health, Environmental Health.



## Results

### Imaging:

31.1% of flow imaged

### Counting:

86.5% of particles counted

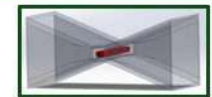
**Total Accuracy: 26.8% of flow**

### Data extrapolation:

- Extend data to larger volume with confidence interval

### Future Test:

- Outdoor performance test compared to market competitor



Analysis of imaged flow

