EECS 507 Project Presentation

Electronic Nose in Food Storage Container

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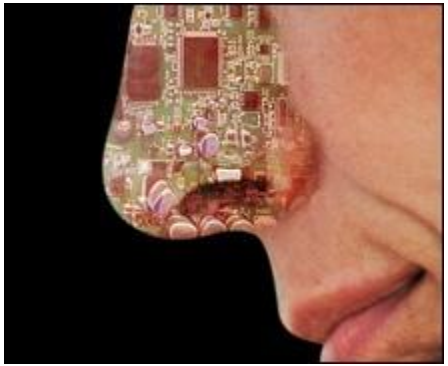


Agenda

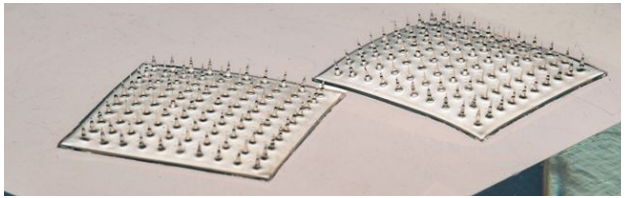
1. Introduction
2. Related work
3. What is an electronic nose?
4. Project design
5. Results
6. Practicality
7. Challenges
8. Future Work


RIP

Background and motivation

- Food timing is important
- Peak time = most nutritious
- Decay = less nutrients
  - More microbes
    - Illness and death
- Food safety big sector

Related Work



MIT Velcro-like food sensor (mechanical system)

- Color-changing array of silk microneedles
- detects spoilage and bacterial contamination

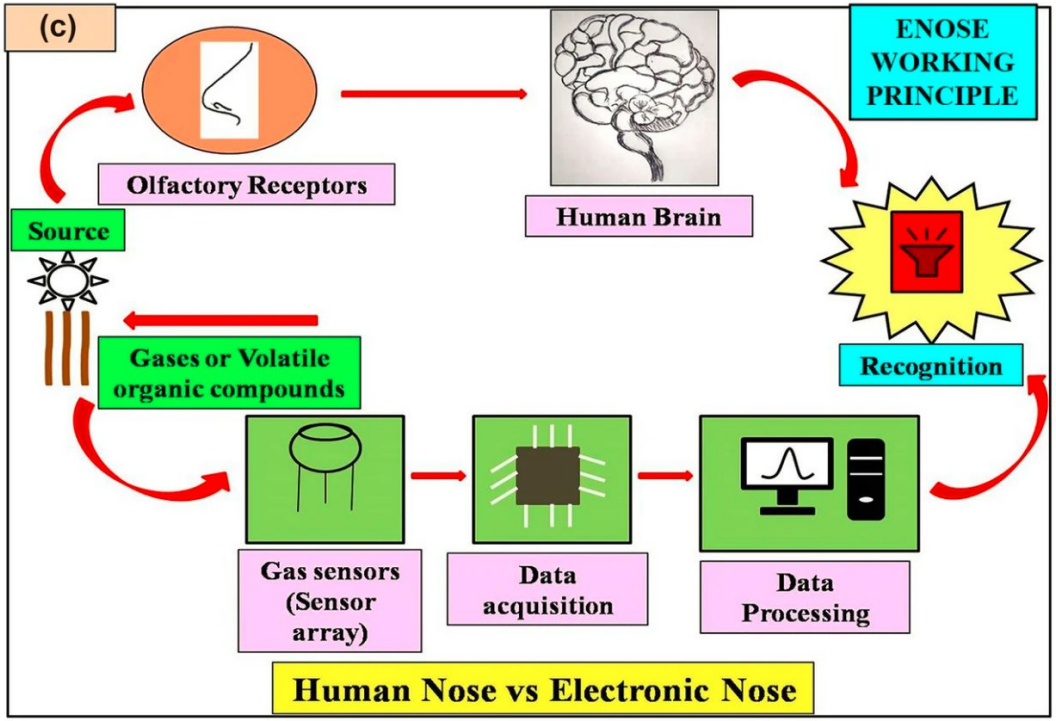
Peres - Electronic nose

- Measures Volatile organic compounds
- Results in an App

Smart Expiry Food Tracking System

- Timer based on date of expiration

What is an electronic nose (e-nose)?



Project Idea

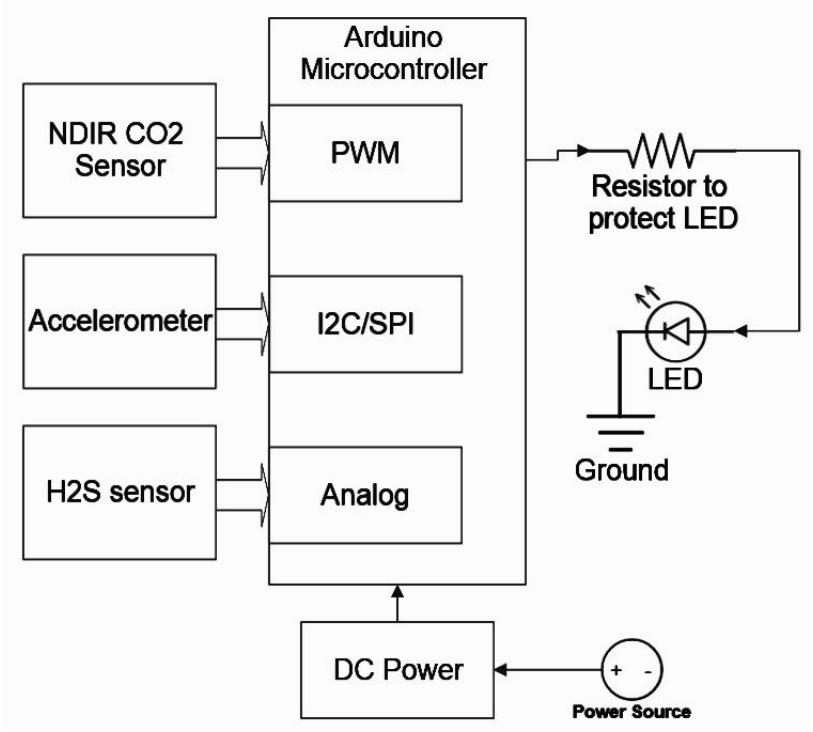
- Food storage container with embedded electronic nose
  - Average person
    - Max Impact
  - Integrated
  - Reusable
  - Avoid touching food
    - Metal & chemicals

Why?

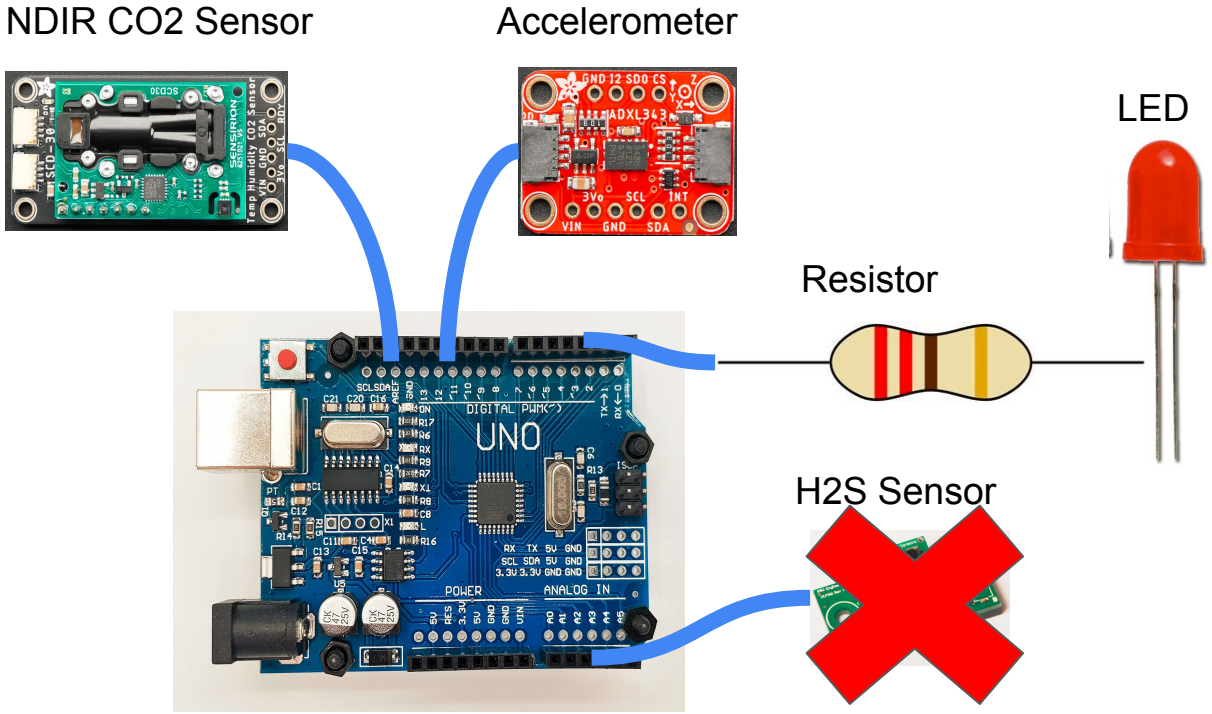
- Not re-creating an electronic nose

- After preparation monitoring
  - Is the food still good to consume?

System Diagram



System Diagram



Algorithm

5 stages

1) **Initialization and Reset:**
   a) Make sure sensors are functional
   b) Initial baseline reading

2) **Data Acquisition:**
   a) Turn on sensors, collect data, turn off

3) **Data Processing:**
   a) Process data and Store result if drastically different
   b) Food is bad?
      i) Flag

4) **Sleep stage:**
   a) Sensors off
   b) Check accelerometer as an interrupt
   c) LED for bad food

Addressing Embedded System Constraints

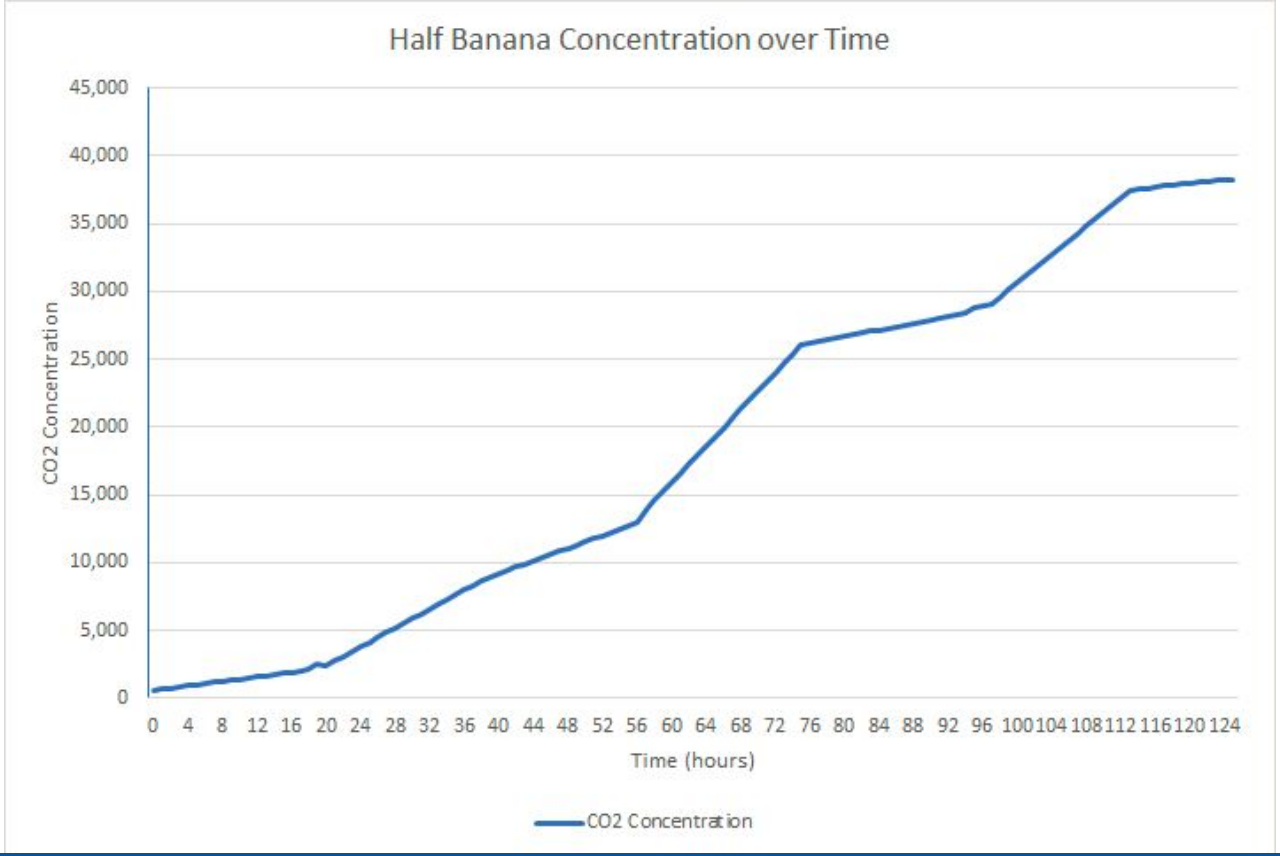
- Low power
  - Used sensors that don’t need to heat up
  - Sensors aren’t on all the time
  - methods to limit time LED is on
- Small
  - Prototype is not small or portable
- Cost
  - Prototype is not cheap
- Real-time constraints
  - Check as frequent as needed
- Limited memory
  - Few data points
- Market?
  - Hobbyists and medical researchers

Food 1 (Single Slice of Bread) - Results

Food 1 (Single Slice of Bread) - Analysis

- Expected Exponential curve
- Threshold
  - Hour 174 ~ 1k per hour
  - Hour 184 ~ 2k
- Visible mold growth at 169
- Repeated thrice
  - Accuracy = 80.7432 %
  - Threshold of 169 Hours

Food 2 (Half a Banana) - Results



Food 2 (Half a Banana) - Analysis

- The banana gives off CO_2 at different rates
  - Respiration
- Gives off a lot of CO_2
- Started growing mold at hour 105
- No distinct threshold

Major Change!

- Rate of change cannot be used in the same way
  - New Algorithm - K-NN classifier
    - Thresholds
    - From day 4-5.5 classified as bad

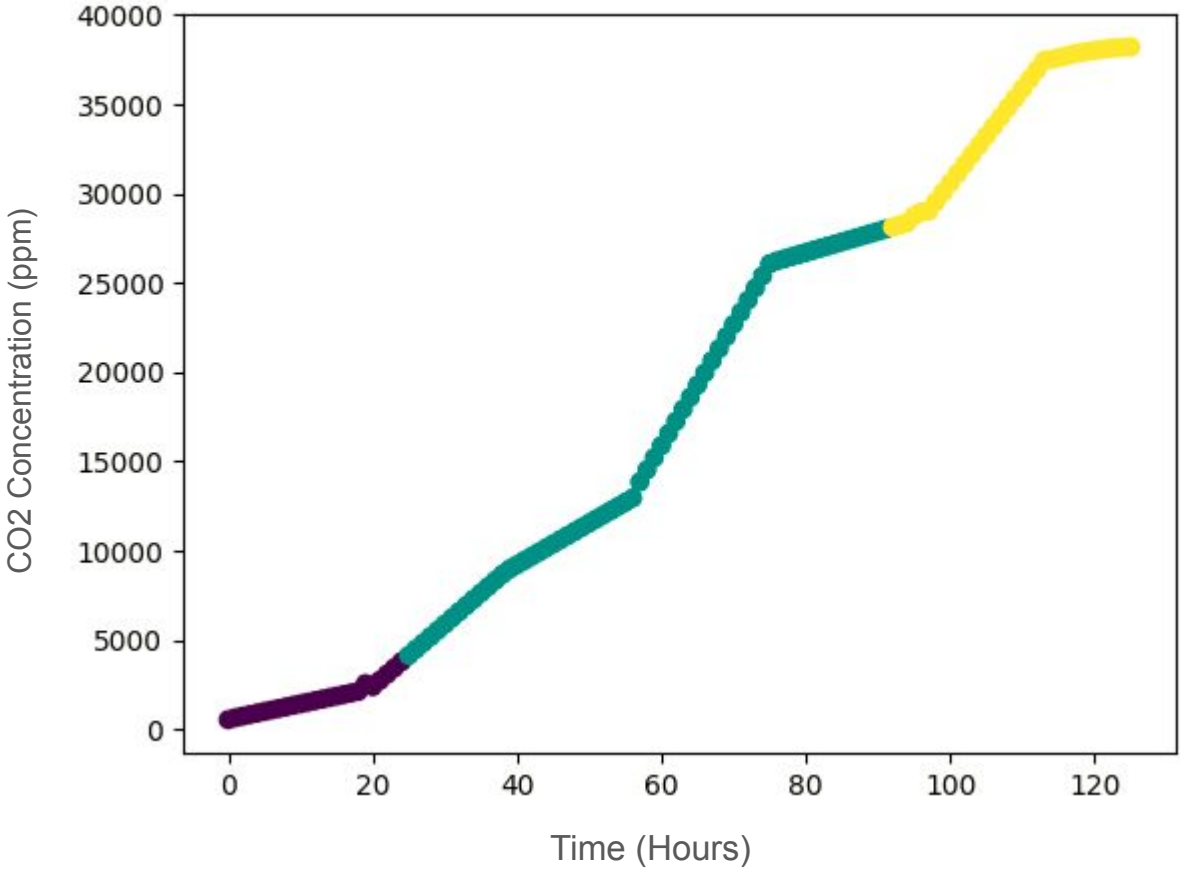
- Embedded system wise
  - Increase in memory
  - Increase in power
  - Increase in time

K-NN Algorithm

Classify into 3 categories:

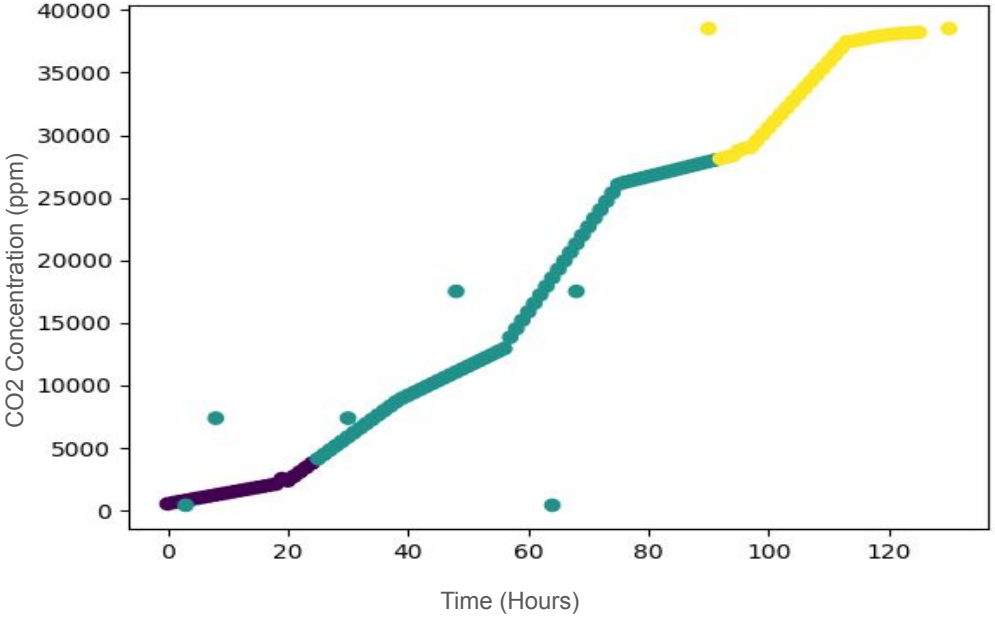
- Unripe
- Ripe
- Overripe

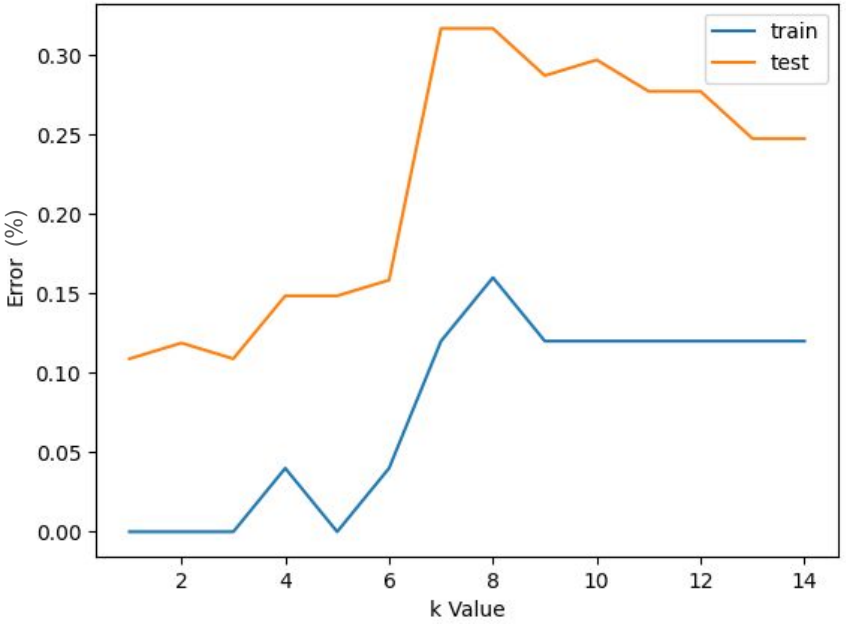
Process:
Use trained classifier to classify new data point



K-NN Algorithm

- Accuracy: 89.11% with K= 3
- Avoidance of class 1





Practicality

- System was about ideal
  - Human Interaction
  - Gas Exchange
  - Food Lifespan - time
  - Food Lifespan - Fresh to Unsafe

Challenges

- Maxing sensor input
- Overabundance of data points
- I^2C
  - Conflicting addresses
  - Pull up-resistance
- Vagueness in food niche

Future Work

- Combine multiple sensors
- Dynamic thresholds
  - Different scales
  - Different food
- Know food type
  - Manual entries
  - Sense food
  - Master meat or dairy
- Feedback
  - Phone notifications

Citations

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Questions?