

# ECE 445 Team 1: Waste Bin Monitoring System

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DELETE THIS SLIDE  
WHEN WE ARE DONE

1. Introduction to your team and your project.
2. Objective. What problem are you solving?
3. Brief review of original design, statement on areas of design that changed, and overview of each functional block's requirements.
4. Description of project build and functional test results. You can choose to include a short (30s) video of your project here.
5. Discussion of successes and challenges, as well as explanations of any failed verifications demonstrating and understanding of the engineering reason behind the failure
6. Conclusions from the project: what did you learn, what would you do differently if you redesigned your project, etc.
7. Recommendations for further work.

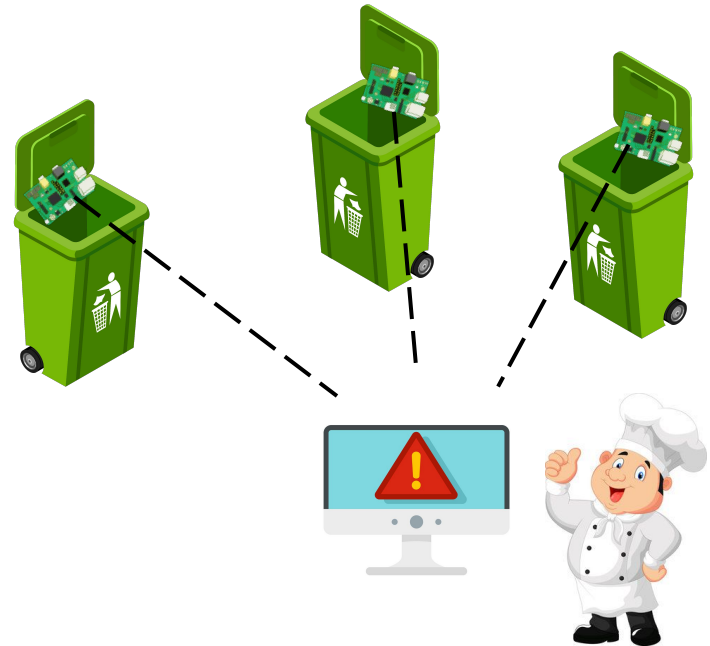
Any significant, relevant ethical issues should be briefly addressed, preferably in a single slide. (Both Allen and Ben)

# Introduction

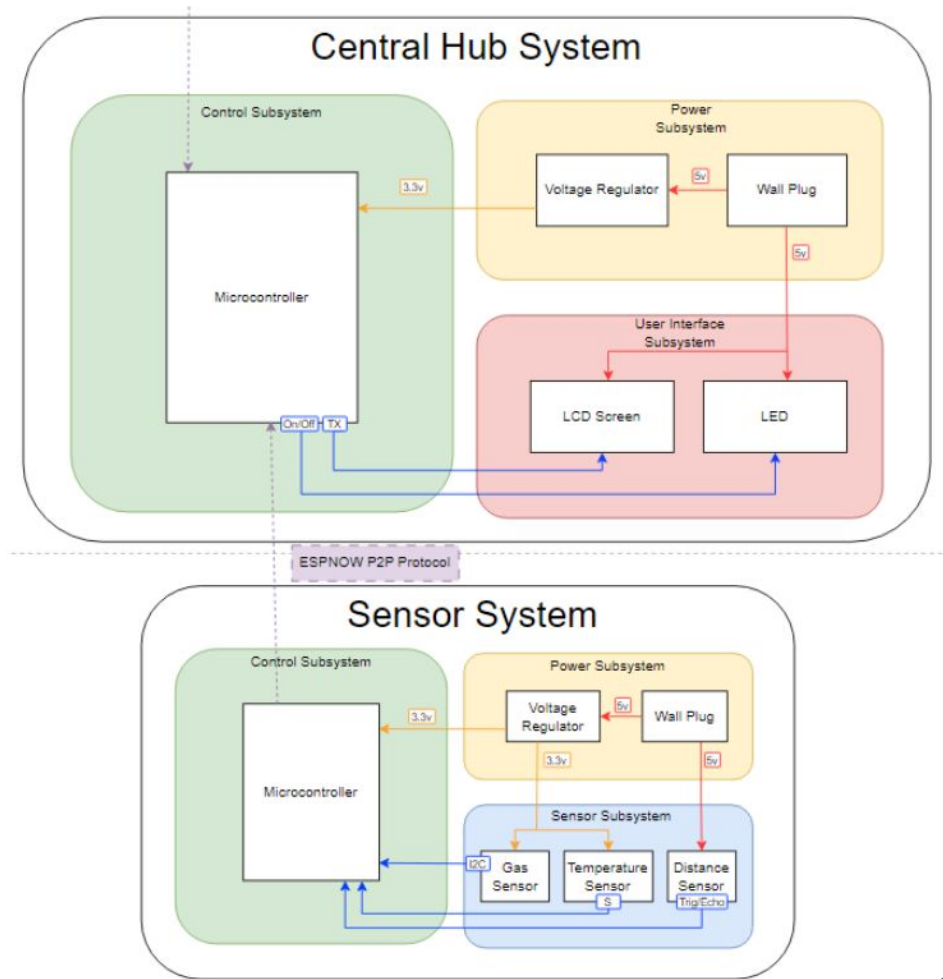


# Objective

- Sensor tags on trash cans
- Central hub for restaurant staff
- Simple-as-possible setup and wireless comms.



# Original Design Overview



# Subsystems

**Sensor subsystem:**

HC-SR04 Ultrasonic

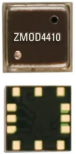


DHT-22 Temperature/Humidity



ZMOD4410 Gas Sensor

- Found unsuitable (details on later slide)



Changed gas sensor to MQ-135 Gas Sensor



# Subsystems (cont.)

**Power subsystems:** 5V->3V3 regulator

**Control subsystem:** ESP-32

**User Interface Subsystem:**

Nextion LCD screen



# Description of Project Build, Test Results



Hub Board



Sensor Board x 2



Final Product







# Requirements, Verifications, and Results

## Ultrasonic Sensor

Requirement: +/- 5cm distance measured

Verification:



Results:

Actual Distance(cm)	Measured Distance(cm)
65	62.4
53.5	50.8
44.5	46.6
32	33.7
20.5	19.8
12	12.1
9	8.6
4.5	4.3

# Requirements, Verifications, and Results

## Temperature Sensor (DHT22)

Requirement:  $\pm 2^{\circ}\text{F}$

Verification:



Results:

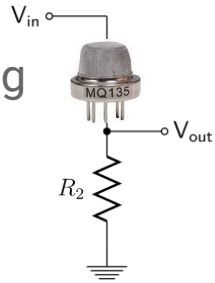
Thermometer Temp(F)	Measured Temp(F)
72	72.0
70	69.9
59	59.6
45	44.4
41	41.1

# Requirements, Verifications, and Results

## Gas Sensor

Requirement: detect noxious fumes ( $\text{CO}_2$ ,  $\text{NH}_3$ , etc.)

Verification: >100 change in analog reading (0.08V) due to exhale



Results: >450 (>0.36V) change observed



# Requirements, Verifications, and Results

## Microcontroller Systems

Requirement: send/receive data within 10 seconds

Verification: measure response time

Results: <2 seconds

# Requirements, Verifications, and Results

## Power Systems

Requirement: Step input 5V from USB to  $3.3 \pm 0.3V$

Verification: Measurements with multimeter

Results: Steady voltage levels at around  $3.3 \pm 0.1V$

# Challenges

- Gas sensor choice and calibration



- ESP32 soldering and programming
- Sensor board heat generation

# Successes

- ESPNOW protocol
- Sensor accuracy
  - Ultrasonic: < 1 inch precision
  - Gas sensor: ~1000 ppm sensitivity
- Functioning PCBs





# Ethical Considerations



## Privacy:

- Devices gathering data in public areas
- What kind of data is collected and tracked?



## Safety:

- Our product is not a hard rule for changing trash
- Splash safety for electronics

# Conclusions from the Project

## Conclusions:

Product addresses specific issue

Balancing complexity with convenience

- Wifi
- Battery power



# Recommendations for Further Work

- Reduced height/form factor
- Battery system for buffer in power outages
- Balance price point and size vs features

# Recommendations for Further Work (cont.)

- Additional Sensors
- Recalibration
- Improved UI

# Thank You!