Smart Kitchen Air Quality Monitoring and Controlling System

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01

Introduction & Motivation: Kitchen Safety

Why Focus on Kitchen Safety?

3.2 million people die annually due to household air pollution from cooking

Fine particulate matter that's 10 microns in size can enter the bloodstream and lungs

Particulate matter (PM) is 65 times higher after cooking.

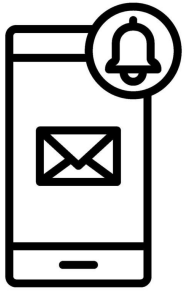
Our Goals

- Ensure **safe cooking environments** for newer homes
- Allow users to understand the gases they are being exposed to and **alerting** them when necessary
- Taking **precautionary steps** when gas levels exceed the threshold

Primary Functions

1. Using **sensors to detect air quality** and various gases such as CH4, CO and LPG

2. Providing a **tracking method** to allow users to identify spikes and track history

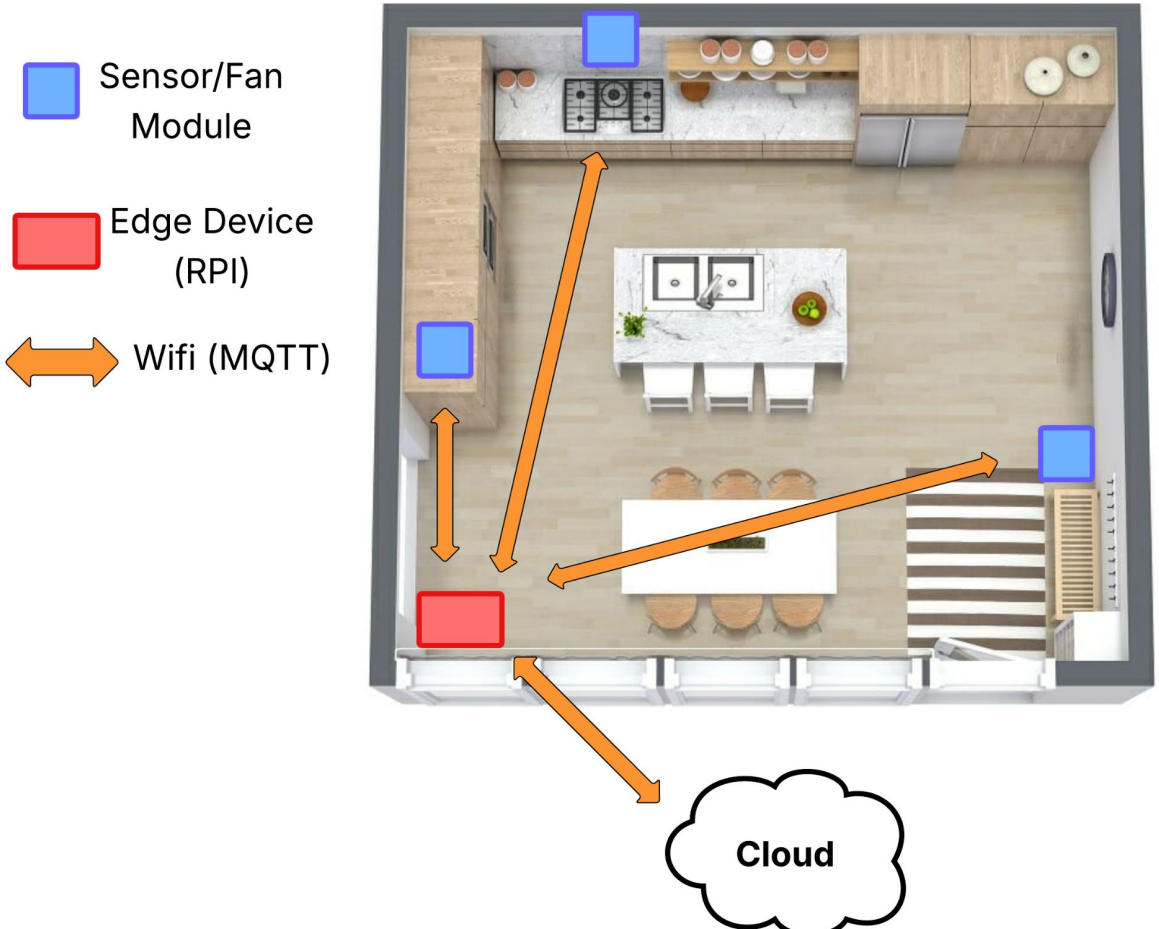


3. Operate a fan to mimic a **ventilation system** when poor air quality detected

02

System Design

System Architecture

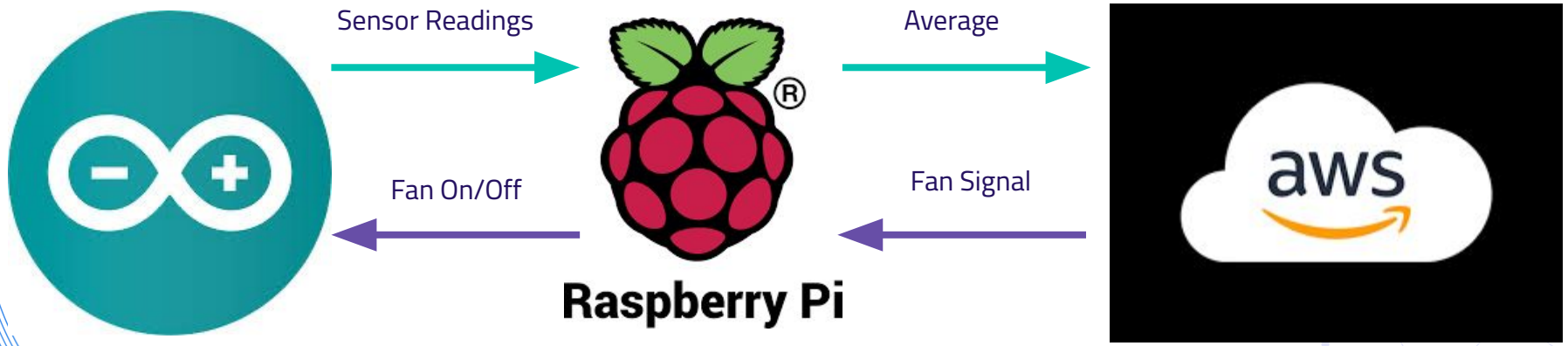


System Architecture

1. IoT Device(s)

2. Edge Device

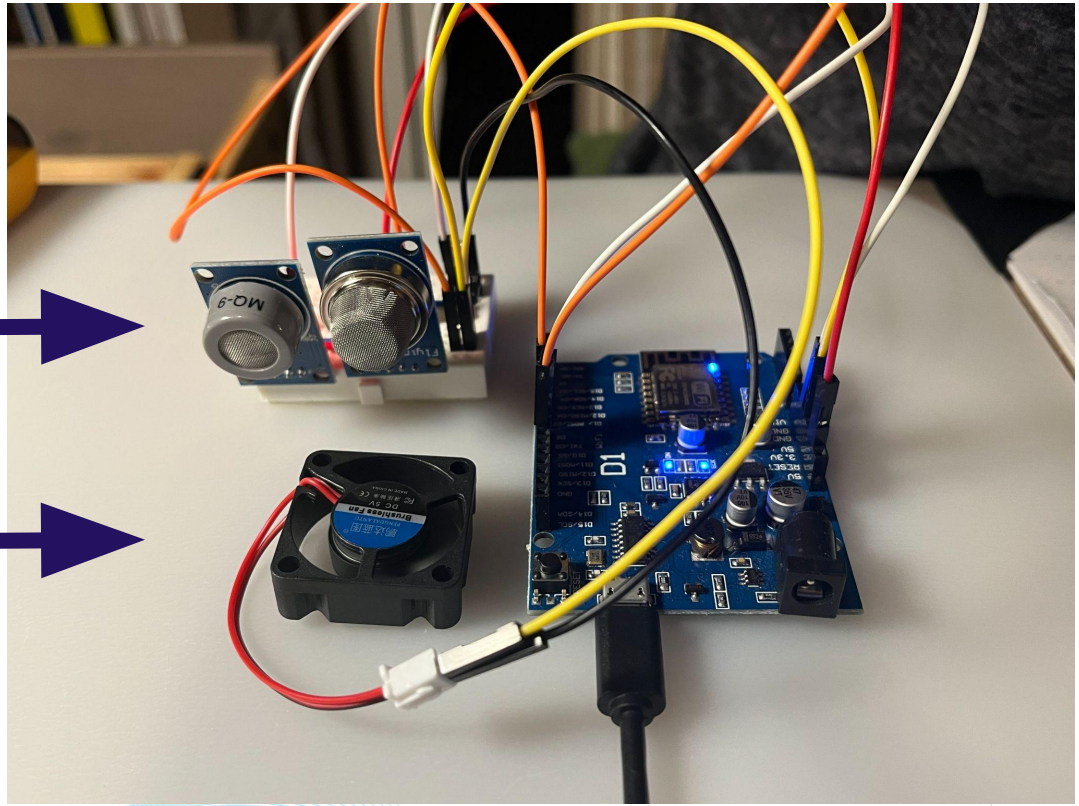
3. Cloud Server



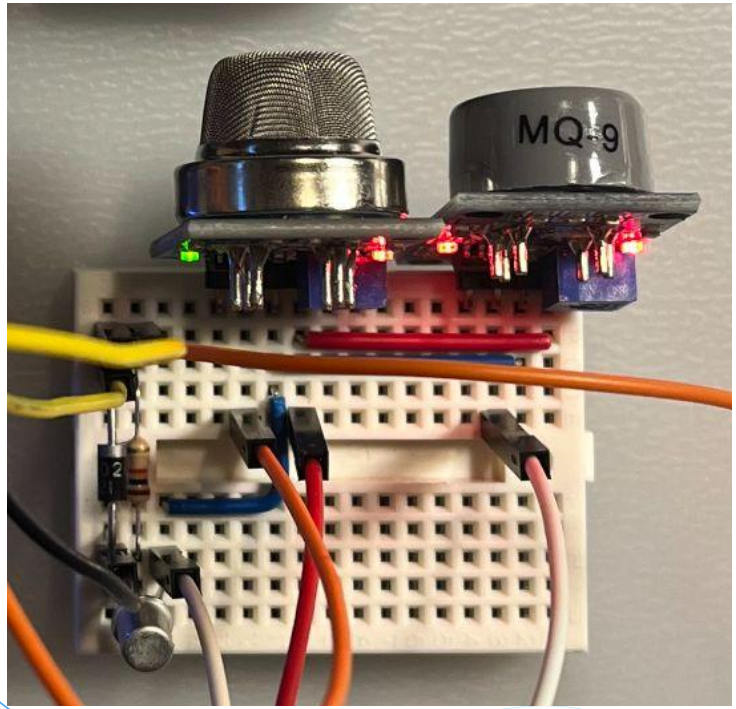
Sensor/Actuator Module

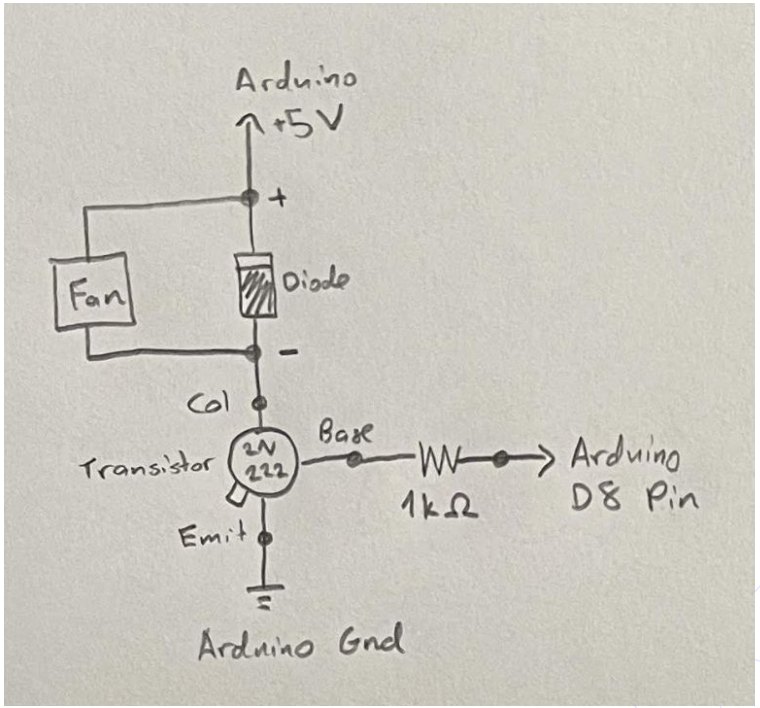
Air Quality &
Gas Sensor

DC Ventilation
Fan



Sensor/Actuator Module: Fan Activation

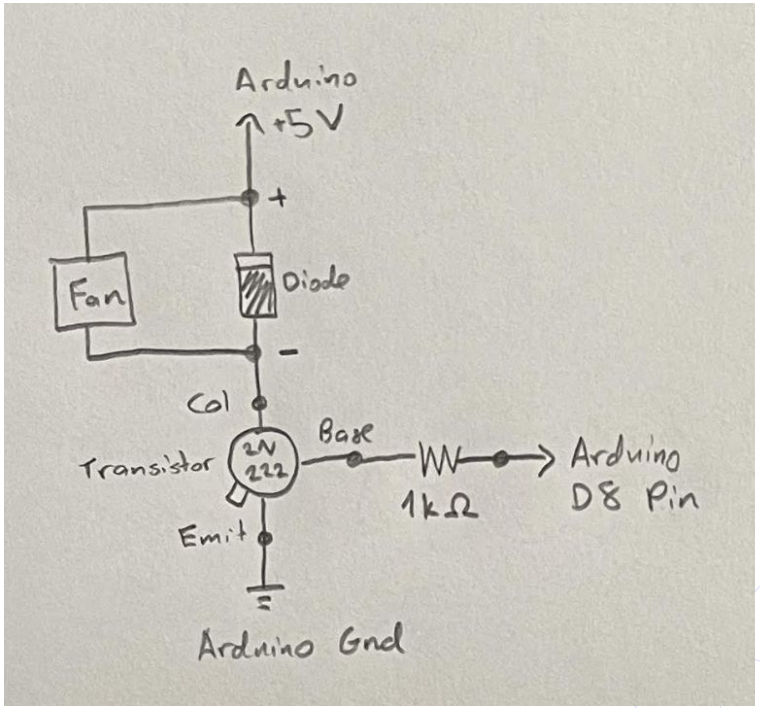




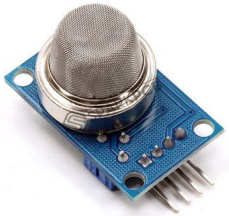
Sensor/Actuator Module: Fan Activation

Power Fan On/Off by switching it On/Off from Arduino's 5V using:

- Transistor
- Diode
- Digital Pin (Switch Transistor On/Off)



Sensor/Actuator Module



Components:

- Air quality sensors:
  - **MQ-135 Air Quality sensor**
  - **MQ-9 Carbon Monoxide & Flammable Gas Sensor**
    - Easy to read from (digital/analog pins)

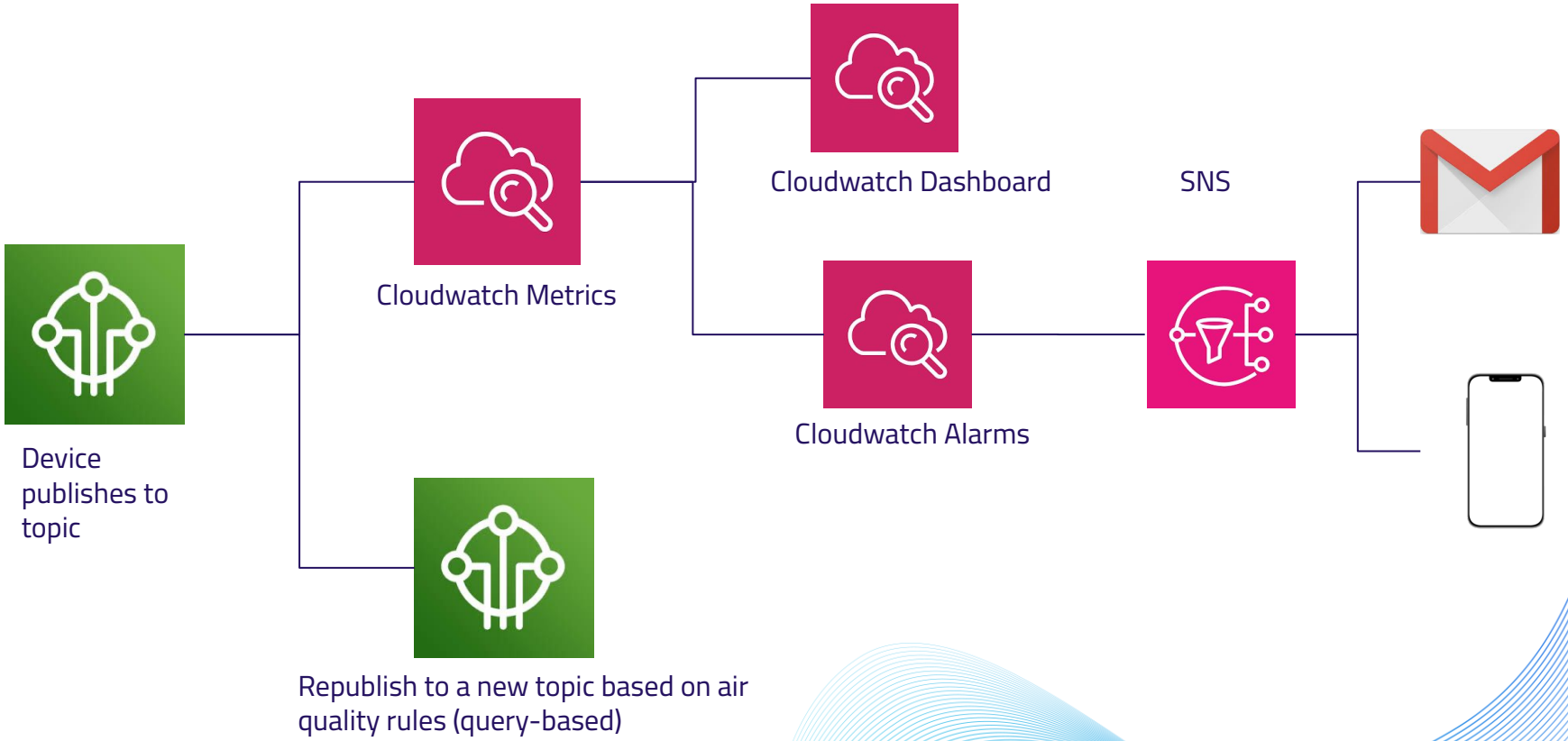
- Ventilation Fan:
  - **5V Cooling Fan**
    - Power using Arduino 5V + Transistor + Digital Pin

- DC Power Supply:
  - **9V Battery**
    - Not enough V, I to power all components
    - Need larger Voltage, or LiPo Battery

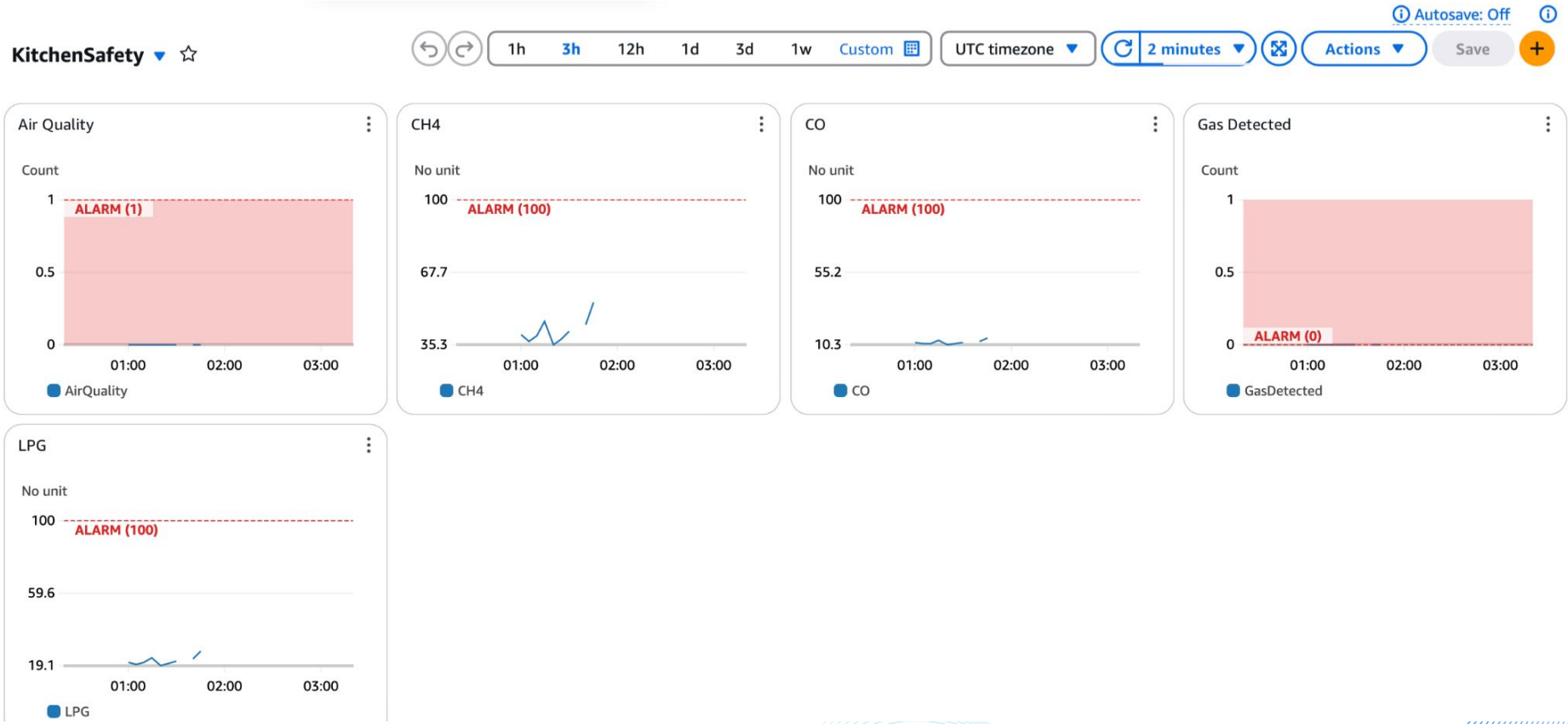
03

Additional Features (AWS)

Cloud Architecture

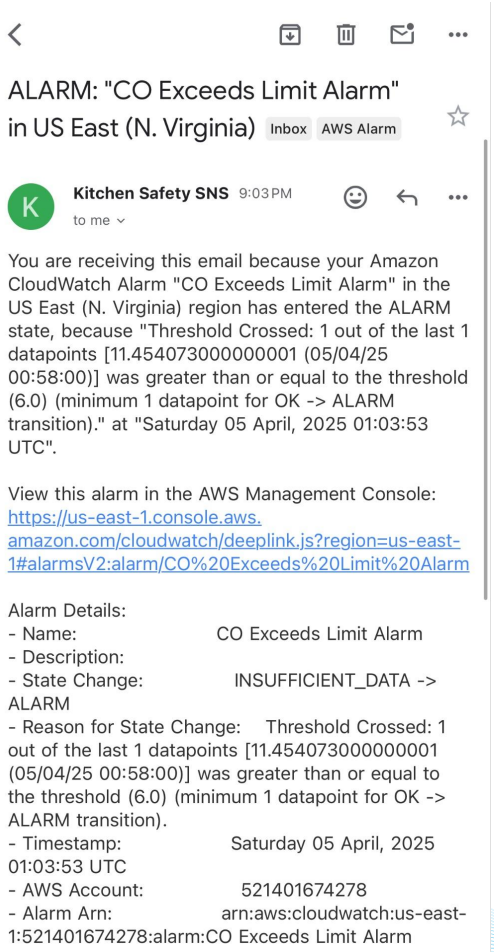


Cloudwatch Dashboard



Cloudwatch Alarms

- Email notifications
- Text Notifications



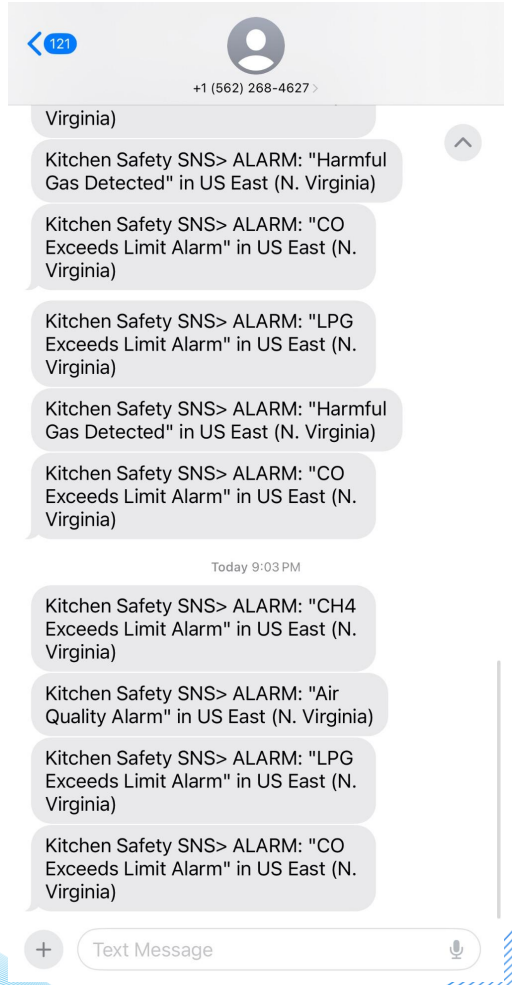
ALARM: "CO Exceeds Limit Alarm" in US East (N. Virginia) Inbox AWS Alarm

Kitchen Safety SNS 9:03 PM
to me

You are receiving this email because your Amazon CloudWatch Alarm "CO Exceeds Limit Alarm" in the US East (N. Virginia) region has entered the ALARM state, because "Threshold Crossed: 1 out of the last 1 datapoints [11.454073000000001 (05/04/25 00:58:00)] was greater than or equal to the threshold (6.0) (minimum 1 datapoint for OK -> ALARM transition)." at "Saturday 05 April, 2025 01:03:53 UTC".

View this alarm in the AWS Management Console:
https://us-east-1.console.aws.amazon.com/cloudwatch/deeplink.js?region=us-east-1#alarmsV2:alarm/CO%20Exceeds%20Limit%20Alarm

Alarm Details:
- Name: CO Exceeds Limit Alarm
- Description:
- State Change: INSUFFICIENT_DATA -> ALARM
- Reason for State Change: Threshold Crossed: 1 out of the last 1 datapoints [11.454073000000001 (05/04/25 00:58:00)] was greater than or equal to the threshold (6.0) (minimum 1 datapoint for OK -> ALARM transition).
- Timestamp: Saturday 05 April, 2025 01:03:53 UTC
- AWS Account: 521401674278
- Alarm Arn: arn:aws:cloudwatch:us-east-1:521401674278:alarm:CO Exceeds Limit Alarm



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Virginia)

Kitchen Safety SNS> ALARM: "Harmful Gas Detected" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "CO Exceeds Limit Alarm" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "LPG Exceeds Limit Alarm" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "Harmful Gas Detected" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "CO Exceeds Limit Alarm" in US East (N. Virginia)

Today 9:03 PM

Kitchen Safety SNS> ALARM: "CH4 Exceeds Limit Alarm" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "Air Quality Alarm" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "LPG Exceeds Limit Alarm" in US East (N. Virginia)

Kitchen Safety SNS> ALARM: "CO Exceeds Limit Alarm" in US East (N. Virginia)

Text Message

04

Future Work

Future Improvements

Hardware:

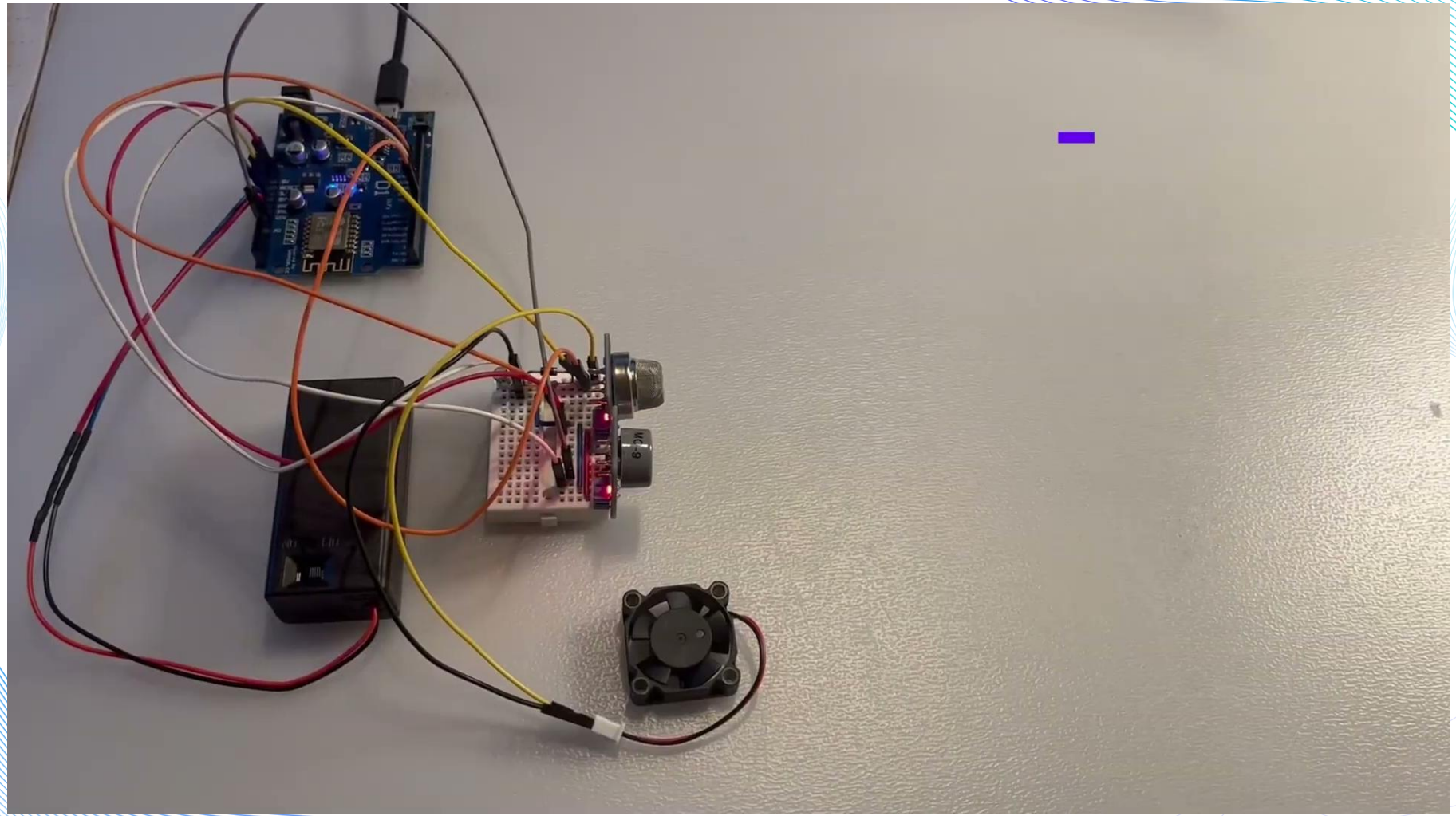
1. Create custom case for Arduino/Sensors
2. Long-lasting powerful battery
3. Better microcontroller (higher edge/computing capability)
4. Higher-precision sensors

Software/Cloud:

1. Integration with Smart Home Assistants (Google Assistant)
2. Smart Fan Control: (variable fan speeds instead of On/Off)
3. Mobile App Integration

05 Conclusion

- Our Smart Kitchen Air Monitoring System provides an **automated and distributed solution** to monitoring and maintaining a safe environment
- Our system is **flexible and customizable** (sensor modules and cloud dashboard/notifications)
- Possible to integrate with other **smart home devices**

06

Demo Video