Automated Air Freshener with Distribution Model

TEAM Design: Term 231

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Introduction

Problem Statement: Persistent air quality issues in large areas prone to pollution call for an automated air fresheners system deployed throughout the area to reduce contamination levels and enhance overall air quality.

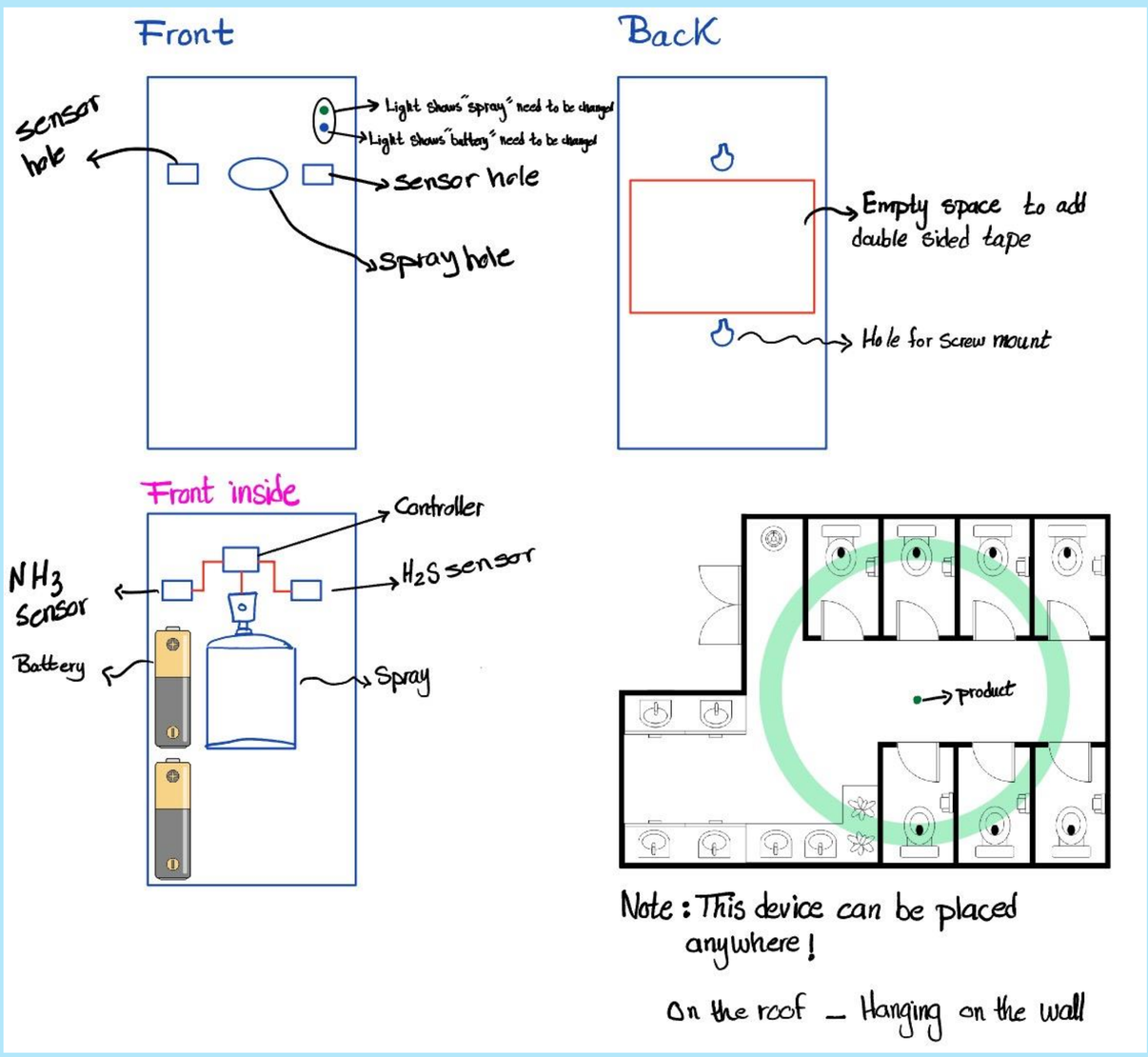
Constraints:

- Time is no more than 3 months.
- Budget is limited to 6000 SAR.
- Impediments, (e.g., cameras, smoke detectors, etc.) for placing the product in optimal place.

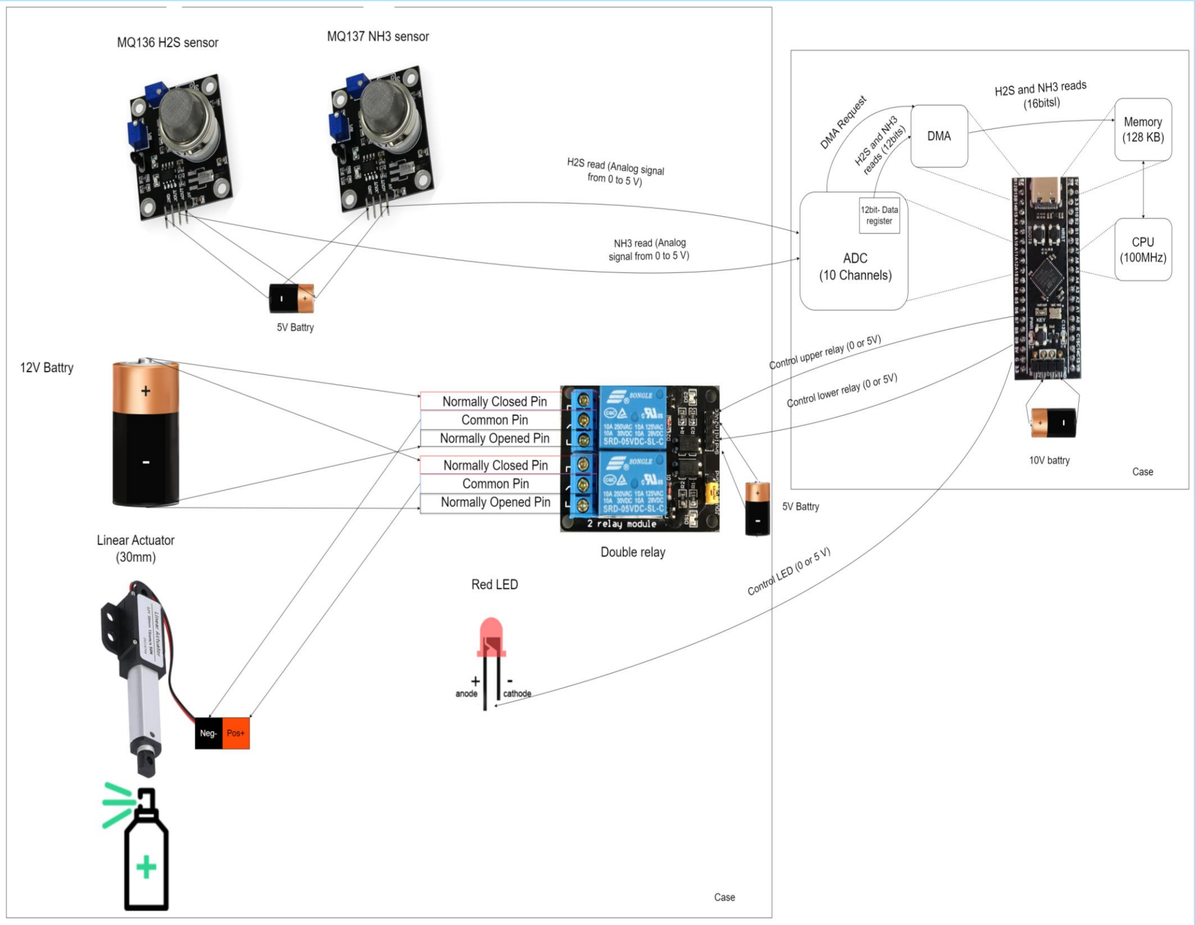
Specifications:

- Spray coverage of 48 cubic meters
- Concentration level less than 1 ppm for H2S and less than 25 ppm for NH3
- Spray capacity of 250 mL
- Power consumption rate of 3 W

Conceptual Design

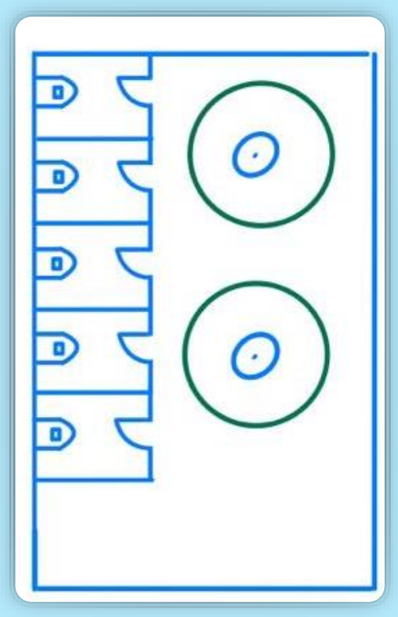


Hardware Design



Distribution Model Design

- **Optimization Problem**.
- Solved by Pure Integer Linear Programming (**PILP**)
- **Parameters**: cost, dimensions (length and width) and radius of coverage.
- **Decision variables**: Coordinates (x,y), number of devices needed.
- **Constraints**: Ensure the area is covered, ensure placement within the area.
- **Objective function**: Minimize total cost.



Testing & Validation

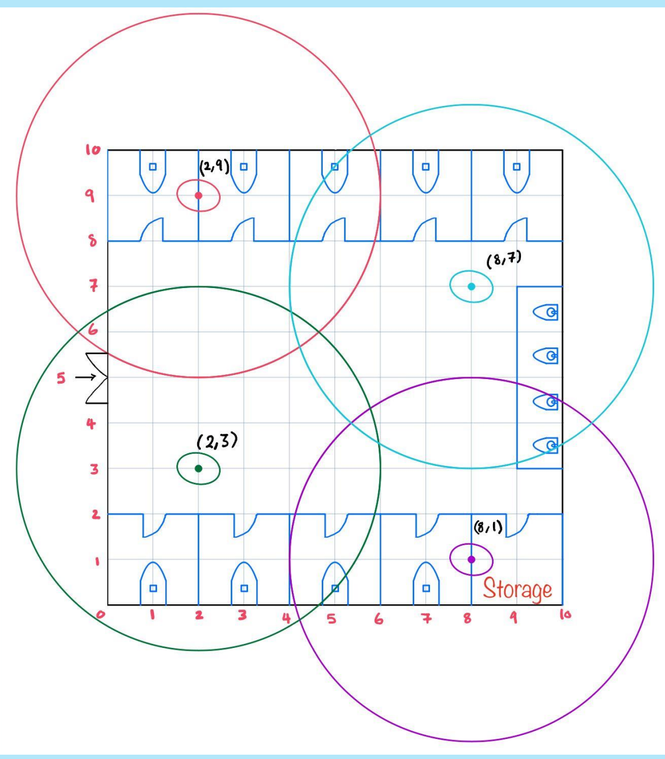
1 Molecular Diffusion in Gases Results

Diffusivity	Molar Flux	Time of Diffusion
$D_{AB} = \frac{\rho_L}{2\,s\,M_A\,(P/RT)\ln(\frac{P}{P-P_A{}^0})}$	$N_{A,z} = \frac{cD_{AB}}{(z_2-z_1)}\ln\frac{(1-y_{A_2})}{(1-y_{A_1})}$	$\Delta t = \frac{\Delta x}{J}$
D_{AB} = 0.0560 cm² / s	$N_{A,z} = 0.0766\,\frac{kg\,mol}{m^2 s}$	$\Delta t = \frac{\Delta x}{0.0766}$

- For a room with a length = width = 4 m and height = 3 m, having the air fresheners fixed at the ceiling pointing down it will take the air freshener approximately 52 s to diffuse in all over the room.

2 Distribution Model

- Optimal Device Locations for 10x10 m² public bathroom



3 Mass Transfer Experiment

- This experiment has been carried out within a fume hood to simulate the conditions found in public restrooms.
- By using two pumps of the air freshener, the concentration of NH3 dropped from 25 PPM to less than 3 PPM in 60 seconds.

Conclusion

In conclusion, this project captures the detailed design and development of our Automated Air Freshener with Distribution Model. Rooted in customer needs, responsive to constraints, and driven by a list of specifications, our product emerges as a user-centric and forward-thinking solution.