**EEL 5666 – Intelligent Machines Design Lab**
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# Robot Proposal

## B.O. bot

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## Abstract

B.O bot is a chemical sensing robot that will be able to tract chemicals and neutralize them. The motivation is to create a robot that will be able to detect a certain “smell’ and determine what to do about it. For ease of demoing and safety of persons involved, Ammonia will be the chemical that will be used to test the robot’s sense of smell. A brief overview of the sensors that are to be used as well as its intended behaviors well be discussed. Also some specifications of Figaro’s Ammonia sensor are discussed.

## Introduction

Many commercial robots today clean carpets and floors but do not address odors. B-O bot will be able to detect a trace gas and determine if the room needs to be neutralized. A special sensor made by Figaro Sensors will allow the robot to detect harmful and unpleasant trace gases measured in parts per million. It is the job of the robot to search a room looking for odors, and once found, will try to find the spot in the room that has the highest concentration of the gas i.e like a spill or bathroom. It will then try to immunize that spot and deodorize the rest of the room. This robots behavior can be supplemented onto current vacuum robots as an added feature.

## Integrated Systems

The main features of the robot will be its gas sensors and the apparatus to spray chemicals. These will be controlled with the Mavric IIB board. The platform will also have some sort of actuator or servos to control the spraying mechanism. Further design is needed before this can be expanded upon. A basic flowchart is shown below depicting the major components.

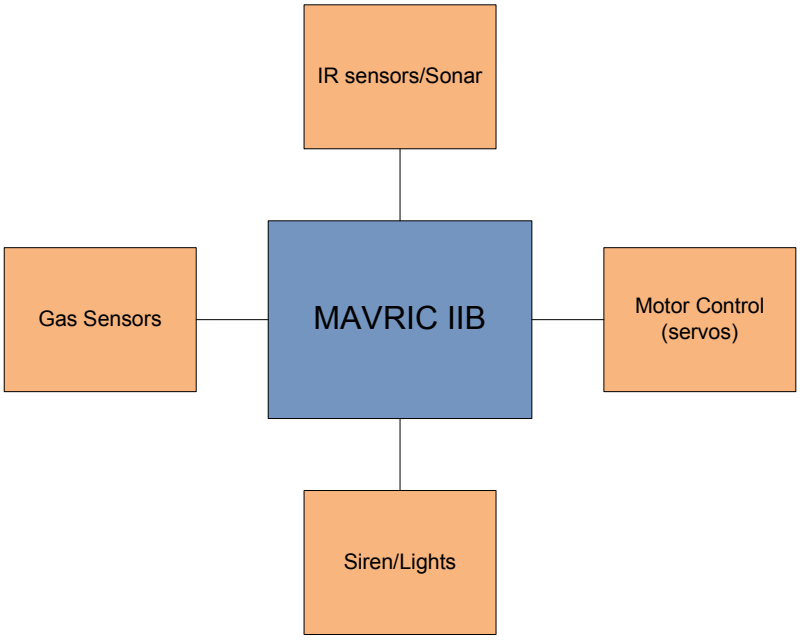


***Figure 1***

## Mobile Platform

The mobile platform will be a flat, one level surface that will have a spraying mechanism on the back of the robot. The design will incorporate cutouts for wheels, probably foam and the front will have the majority of the sensors for the robot. The spraying mechanism will be the majority of the design mechanically. At this time, it is not clear if there will be multiple chemicals that are to be sprayed or that a commercially available spray will be used.

## Actuation

There will be some sort of mechanism that will spray chemicals. At this time it is not clear what or what model of actuator will be used. This will be updated in a future document.

## Sensors

The sensors that will be primarily used will be the Sharp GP2Y0A21YK and the Figaro TGS -826 Ammonia Gas sensor. The design will also incorporate bump switches, and possibly sonar. The Sharp infrared sensors will be used for obstacle avoidance.

*Figure 2 – Sharp GP2Y0A21YK*

The Figaro Ammonia sensor is designed to detect ammonia concentrations from 30 to 300 ppm. For details see figure 5. From the graph in figure 4, the ammonia concentration is almost a linear relationship with ppm. Thus an analog circuit will be designed so that this range can be observed with the Mavric board's Analog to digital port. Also, since this robot is to be used indoors, the relative humidity requirements hopefully are not a concern. See figure 4. This also allows for the use of the infrared sensors. If there is time remaining and budget, I will add sonar for obstacle avoidance and motion detectors for human presence. If there are no humans present, then there is no use in spraying expensive chemicals all over the room. These requirement may change due to the uncertainty of the Figaro's Ammonia sensor accuracy.

*Figure 3 – Figaro TGS-826*

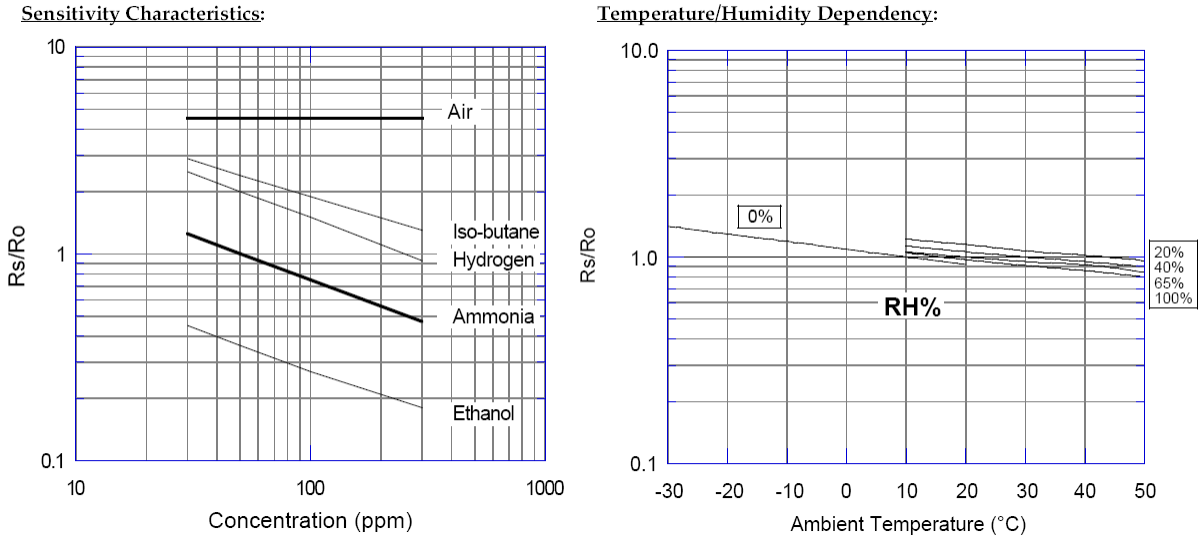


*Figure 4 – Figaro Ammonia sensor concentration and humidity characteristics*

| Item | Specification |
|---|---|
| Circuit voltage (Vc) | Max. 24V (DC only) Ps≤15mW |
| Heater voltage (VH) | 5.0V ± 0.2V AC/DC |
| Heater resistance (room temp.) | 30 ± 3Ω |
| Load resistance (RL) | Variable Ps≤15mW |
| Operating temperature | 30 ~ 50˚C |
| Storage temperature | -40˚C ~ +80˚C |
| Optimal detection concentration | 30 ~ 300ppm |

1-6 *Specifications* NOTE 1

| Item | Specification |
|---|---|
| Sensor resistance (50ppm ammonia) | 20kΩ ~ 100kΩ |
| Sensor resistance ratio (Rs/Ro) | 0.55 ± 0.15 |
| Rs/Ro = Rs(150ppm ammonia)/Rs(50ppm ammonia) | |
| Heater current (RH) | approx. 167mA |
| Heater power consumption (PH) | approx. 833mW |

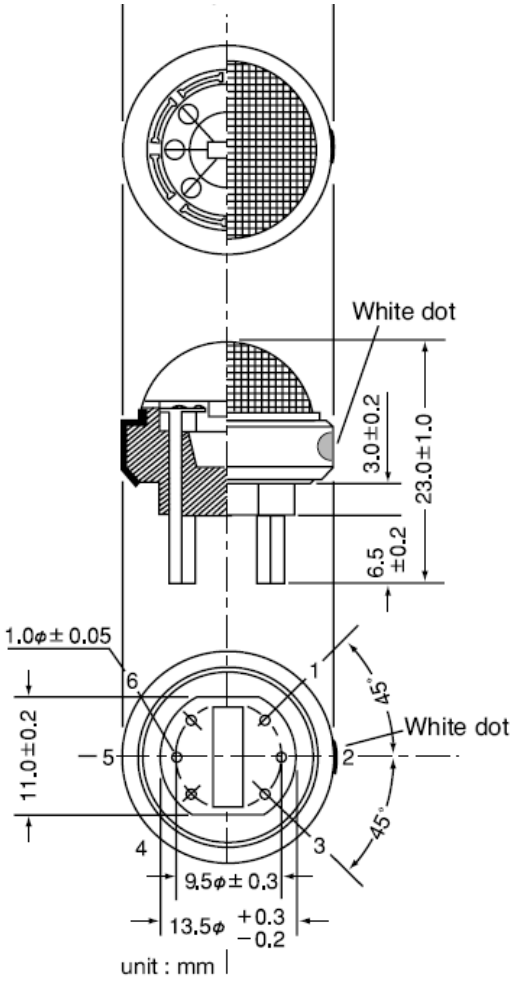


***Figure 5 – Figaro Ammonia sensor specifications***

## Behaviors

The B.O bot will drive around a room and look for offensive odors. Humans can detect ammonia at around 50ppm. This will be the threshold for the robot to do something about the problem. Other gases could have been used, but are dangerous to demo. Ammonia will be the test vehicle for this proof of concept. Once the odor is detected above the threshold the robot will perform these tasks.

- The robot will stop, an alarm will sound. This indicated that eh robot has found concentrations strong enough for human detection.
- It will move in a pattern to be determined to find its source. This part is a guarantee since the sensitivity of the sensor in air environments is not known. Testing is required.
- If the spot with the highest concentration is detected, it will neutralize the ammonia with chemicals... After which, it will move out of the area, and continue roaming.
- An optional sensor that may be added is the human detection. If there are no humans, then the robot will not be looking for ammonia and conserving its chemicals and batteries.

This constitutes the majority of the robots behaviors. This all depends on the accuracy of the Figaro sensor, so testing will reveal its possible accuracy in behaviors.

## Experimental Layout

Since the robot will be sensing Ammonia, household ammonia will be used for testing of the robot. Initial tests will show that the sensor will in fact pick up household ammonia on a towel. For finding the highest concentration, the robot will track in one direction and monitor concentrations. If the concentration is rising in one direction, the robot will continue, if not it will turn and try that direction. Hopefully, testing will show that a towel soaked in ammonia will be the highest concentration. Air currents in a room will affect the results, so testing this will be important.

## Conclusion

The B.O. bot, with the help of the Figaro TGS-826 Ammonia Sensor will be able to sense when a chemical in a room is causing discomfort to occupants in a room. Although this robot has many applications, its motivation will be detecting complex smell. Additional sensors from Figaro can be used to supplement this design and gather more data to determine exactly what could be causing the smell ie. Trash, pet odor, bathrooms etc. It will have many commercial applications if the robot can locate the source of the smell.