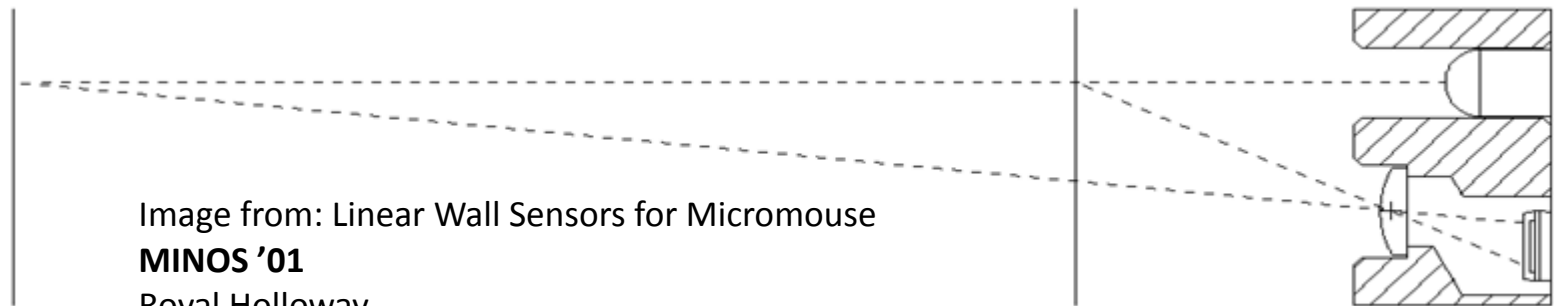


# Zeetah VI Sensor

Harjit Singh

# Introduction

- Zeetah VI has four optical distance sensors.
- The sensors use a position sensitive detector – ala MITee Mouse sensors – where a spot is projected on to the wall and then imaged on to a detector.
- By similar triangle geometry, the location on the detector corresponds to the distance between the wall and the lens.



# Is There Another Approach?

- Except for Dave and me, everyone else is using intensity based sensors.
- Intensity based sensors can be affected by:
  - Wall reflectivity.
  - Ambient lighting conditions.
  - Angle between sensor and wall surface.
- Advantages they have are:
  - They are simpler – mechanically, electrically and optically.
  - They take up less space, weigh less.

# Intensity Based Sensors

- The table on the next slide shows sensor readings with the sensor perpendicular to the wall and then with the sensor slightly rotated ( $\leq 5\text{deg.}$ ) to maximize the sensor reading.
- The surface of the wall has a big effect on the reflected power.
  - Walls with matte finish have the least variability.

# Intensity Based Sensors

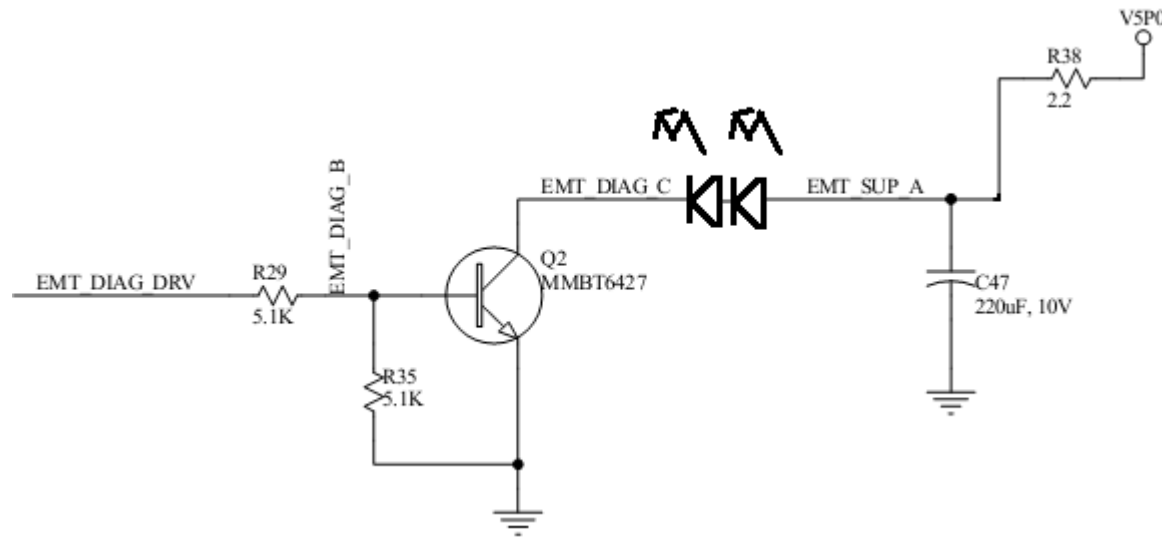
Wall type	Sensor Perpendicular		Maximize sensor reading	
	Left	Right	Left	Right
Singaporean walls	220	230	1080	850
Singaporean walls sanded with steel wool	200	210	260	250
Japanese	277	261	350	352
Melamine - mine	300	256	326	321
Taiwan	265	221	663	586
Taiwan with tape	317	250	360	348
Korean walls	Unable to measure because I didn't have a sample.			

**NOTE:**

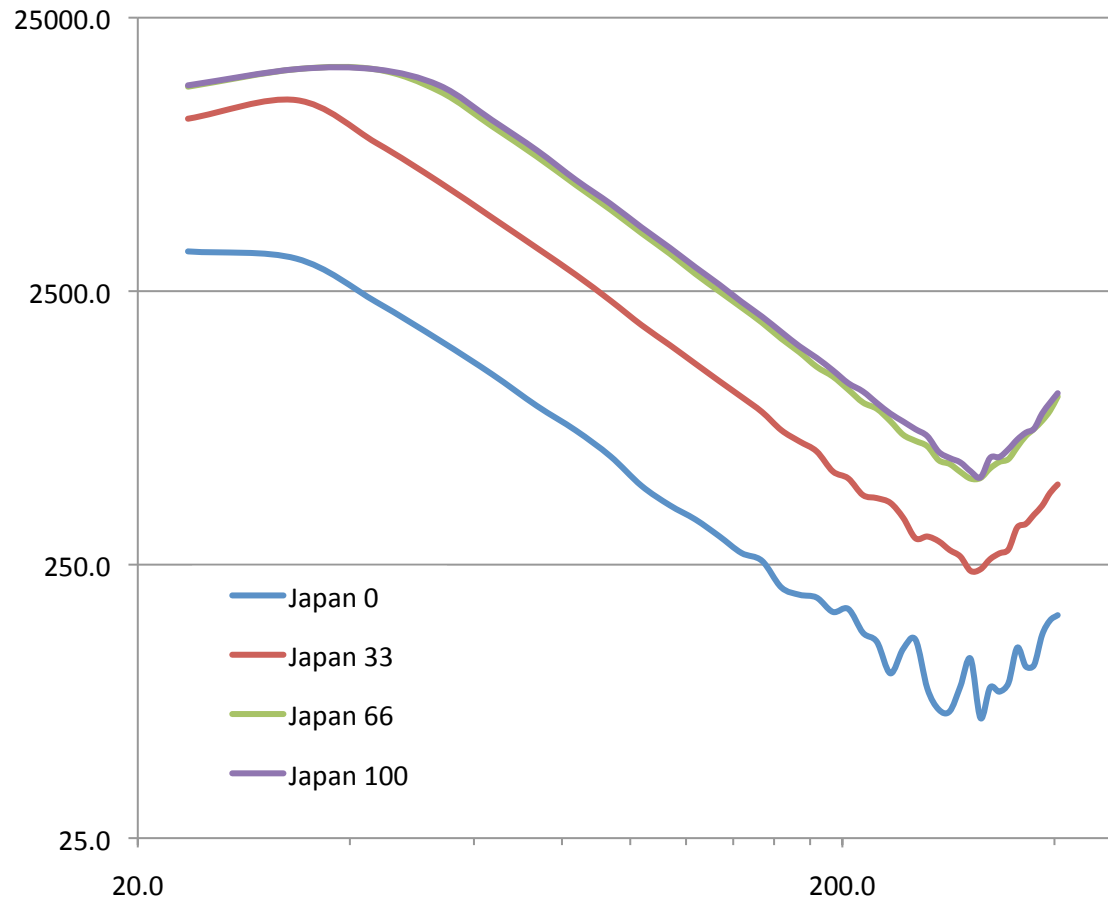
- 1) The distance between the mouse and the wall is the same for **all** readings.
- 2) Only the angle was adjusted (less than 5deg.) between the two sets of columns.

# Zeetah VI Emitter Driver Circuit

- The DAC on the processor (STM32F103) drives EMT\_DIAG\_DRV.
- This makes the emitter drive level programmable – can be changed very rapidly!



# Zeetah VI Sensor Power Measurement



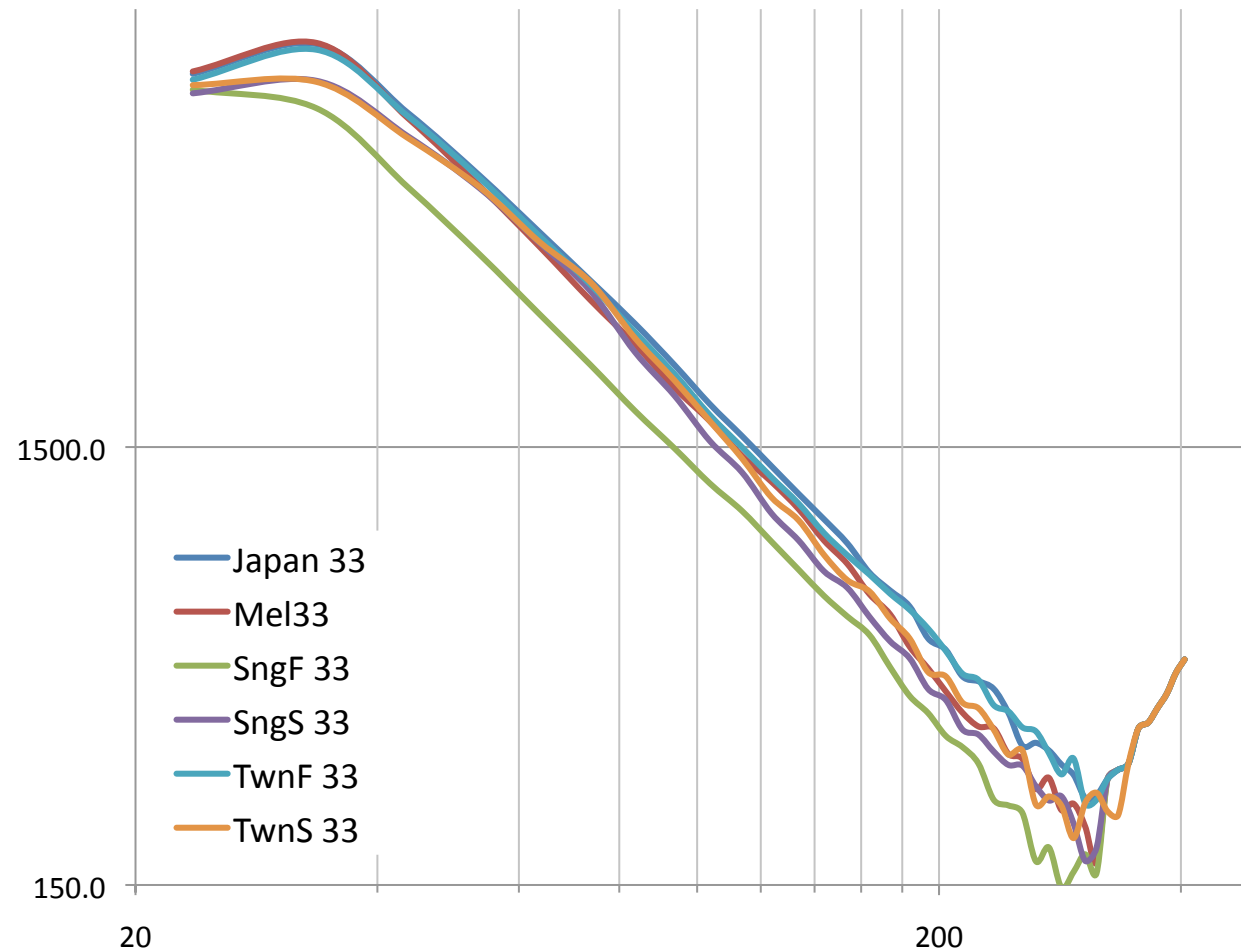
Instead of using sensor data to compute distance, it was treated as intensity data.

**Slope is the same for different drive levels.**

Y-axis: Intensity data  
X-axis: Distance in mm between mouse center and wall.

Log-Log plot.

# Zeetah VI Sensor Power Measurement



Wall type:

Japan: Japanese

Mel: Melamine

SngF: Singapore sanded  
with steel wool

SngS: Singapore shiny (as  
received)

TwnF: Taiwan with tape

TwnS: Taiwan shiny (as  
received)

Y-axis: Intensity data

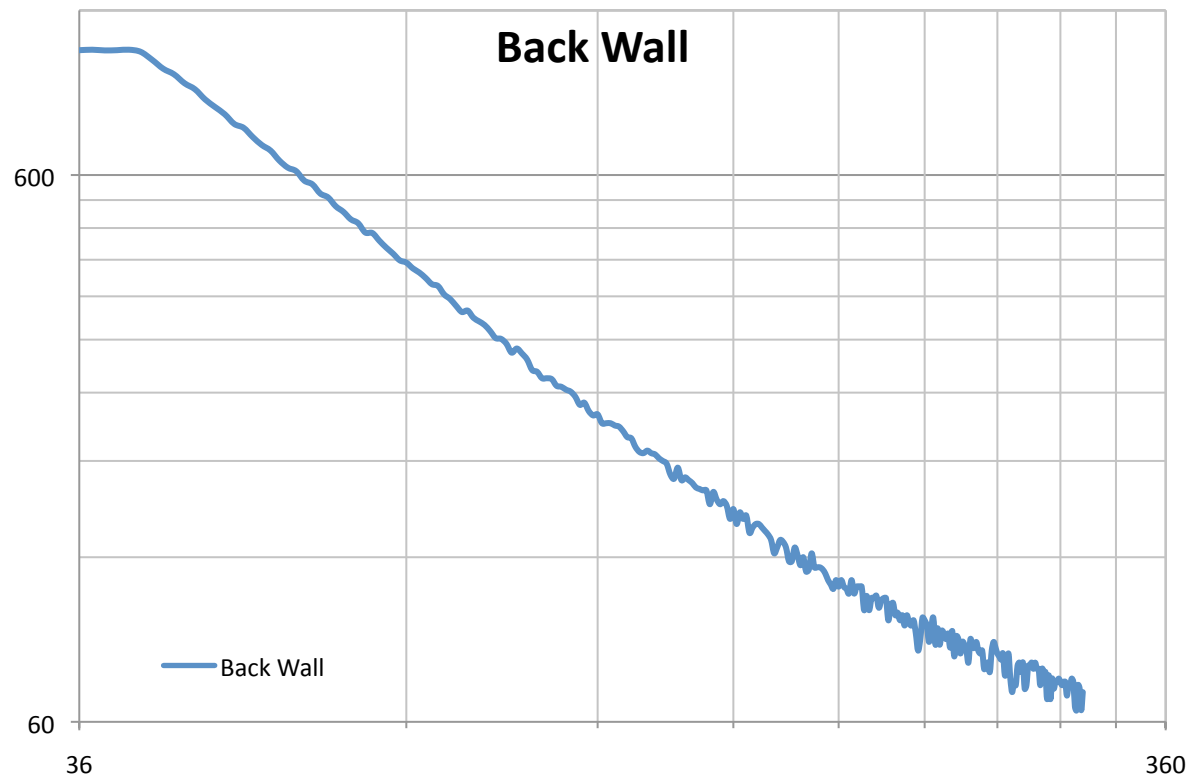
X-axis: Distance in  
mm between mouse  
center and wall.

Log-Log plot.



# Zeetah IV Sensor

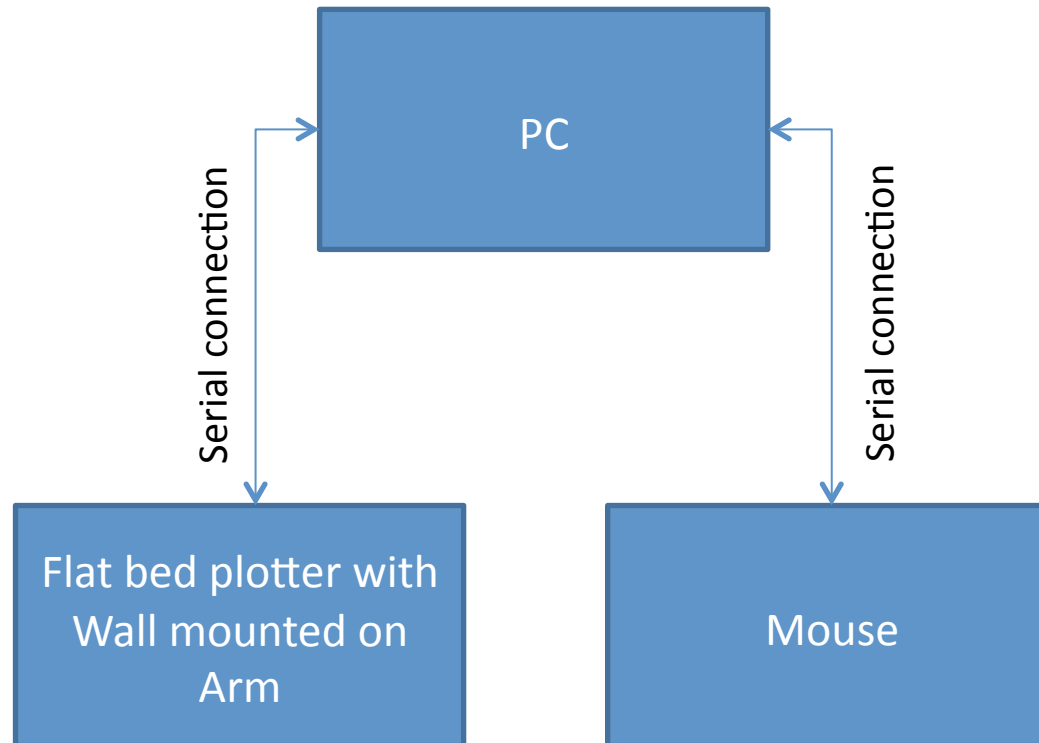
- Uses a photo transistor with an emitter resistor for the detector.
- Not as linear as Zeetah VI but good enough.



# Comments

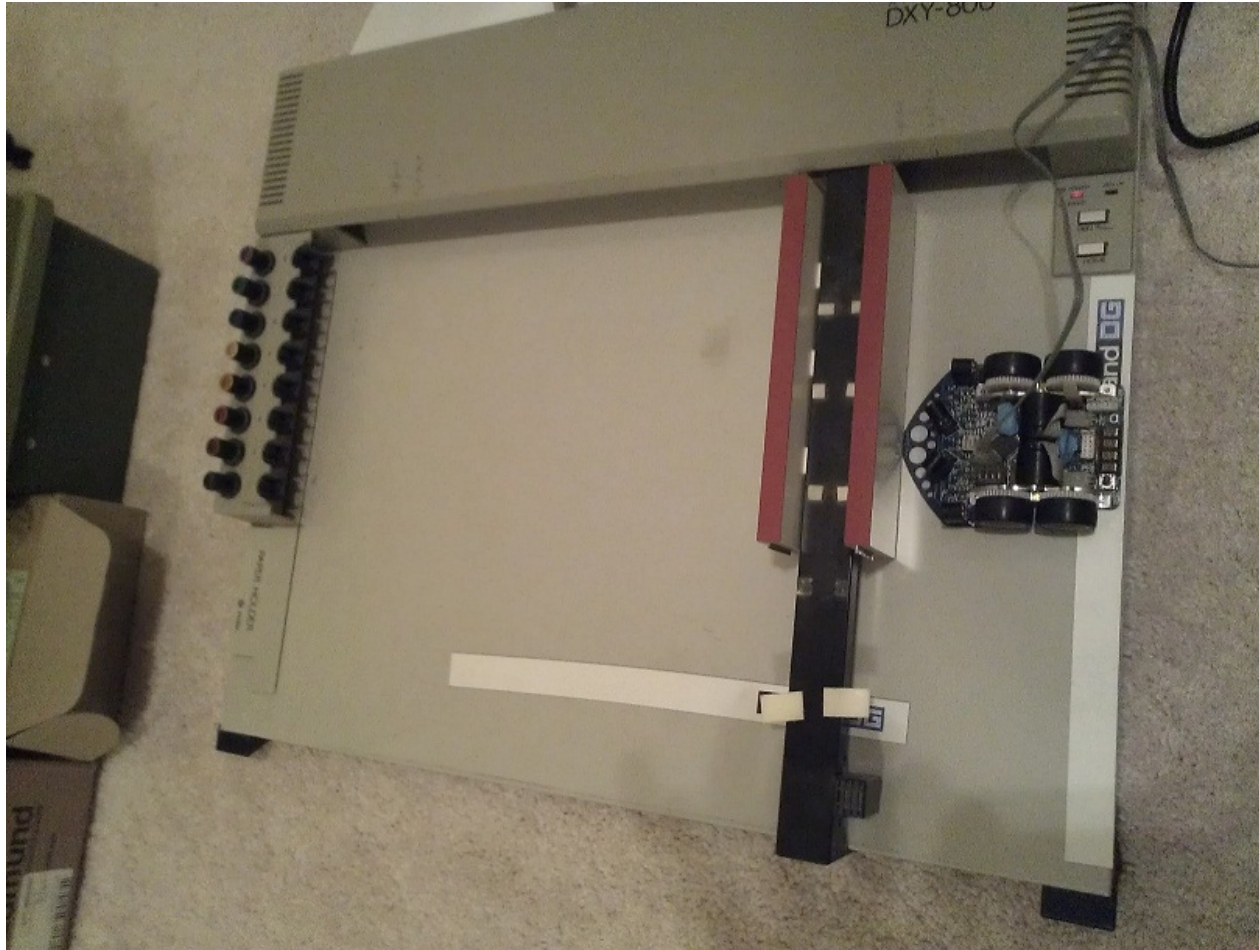
- It was very good to see:
  - That the slope was the same for different emitter drive levels.
  - The different walls had similar slope and offset.
- If we calibrate with one wall type and run in a maze with a different wall type we can either:
  - Changing the emitter drive level.
  - Change the offset.

# Sensor Calibration Setup

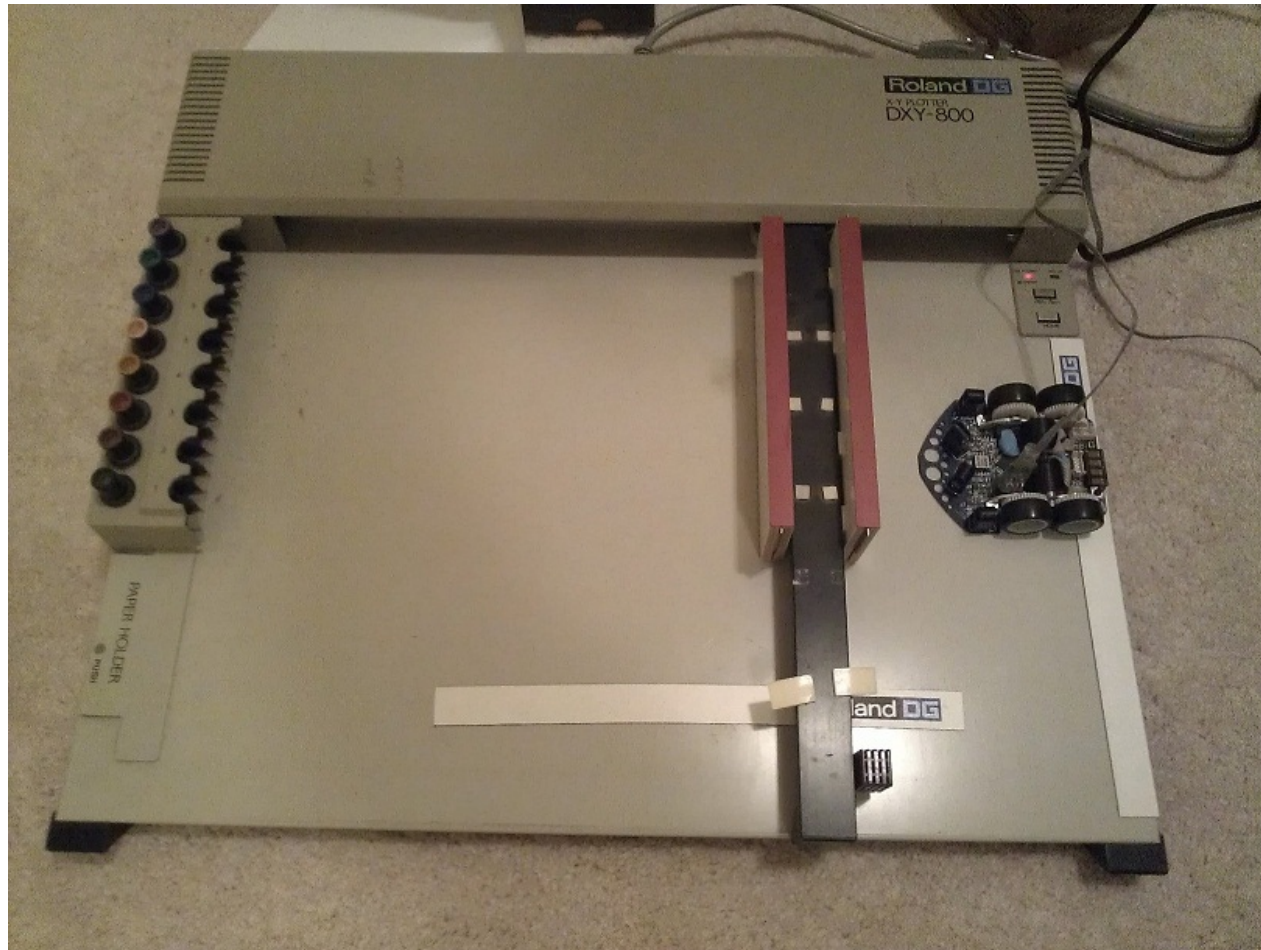


- PC sends command to mouse to read sensors ten times at four different power levels.
- PC commands plotter to move wall by 0.1mm.
- PC records data into a .csv file that is imported into Excel for analysis.

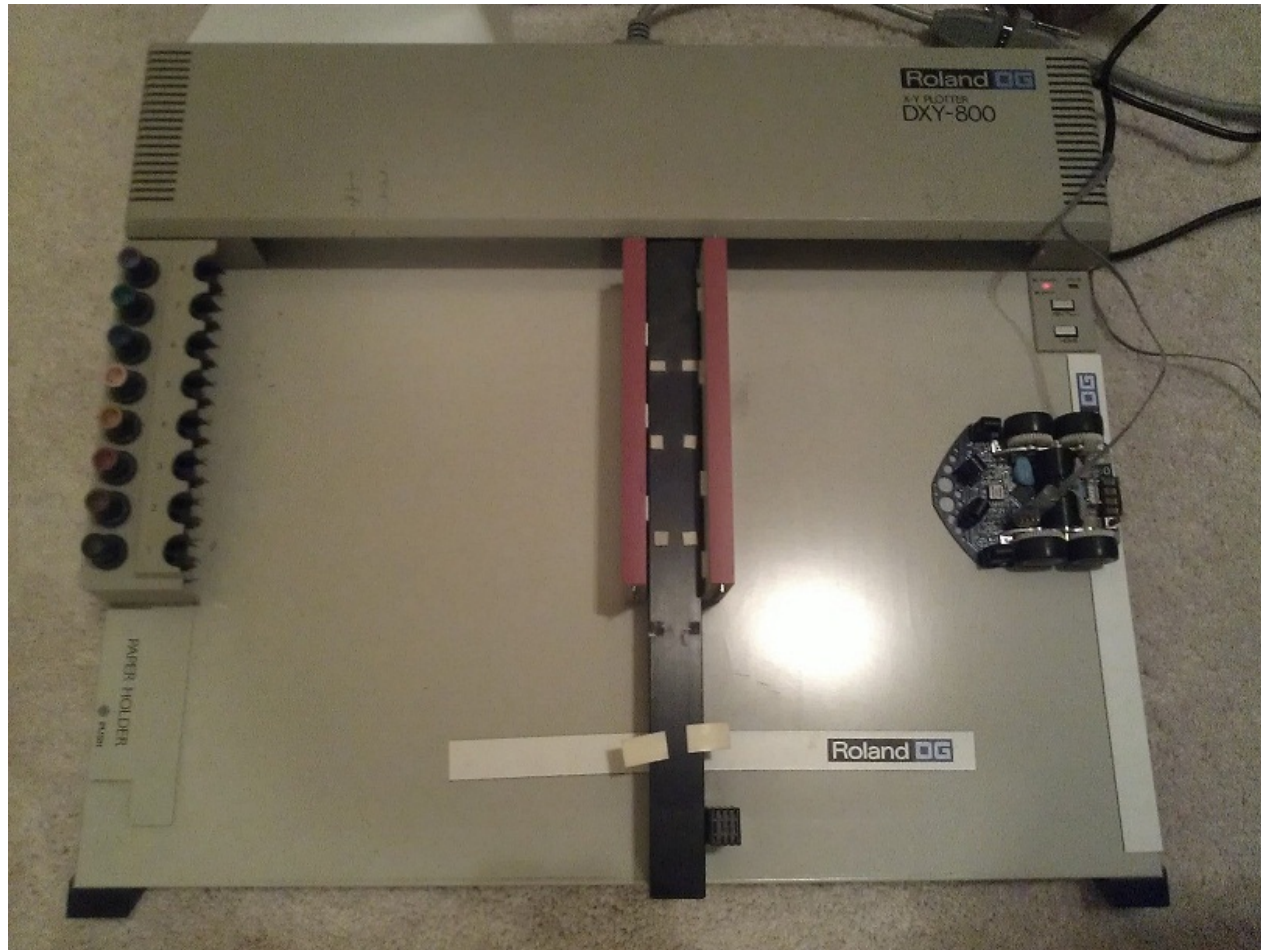
# Front Wall Data Gathering



# Front Wall Data Gathering



# Front Wall Data Gathering



# Front Wall Data Gathering



# Side Wall Data Gathering

