The SMART Weather Balloon - A Mechantronics Demonstration Project

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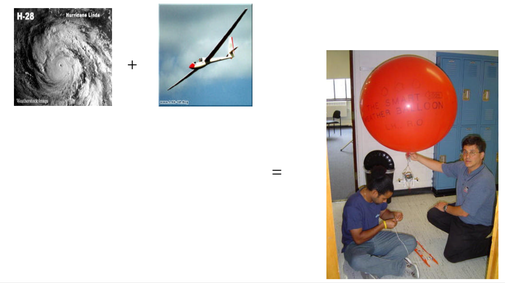
Outline

- **Driving Force –grab students' attention**
- **Mechatronics-blend of mechanics, control theory, computer science, and sensor/actuator technology to design products**
- **Objective- Weather Station, Flight, T, P, RH**
- **Theory**
  - **Isolines, T, RH, P; Sling Psychrometer**
  - **Lift-Force**
- **Homework Board Circuitry w/ SMART Weather Balloon**
- **Results & Conclusions**
- **Future Work & References**

Driving Force: Motivational Moment



Objective

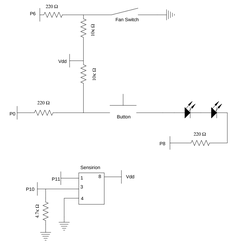
- To engage students and capture their interests. How? By using the Mechatronics concepts learned in this RET program, in the creation of a device that will:
  - –Fly & Take *Real* Weather data
  - –Have students plot their results

Theory – Earth Science

- Isolines: Temperature, RH, P_{bar}

- $F_{lift} = (D_{air} - D_{He})\, V\, g$
- $z = (RT/gM) \ln(p_o/p)$

HWB Circuitry & the Balloon: the Brains of the Show



Data Retrieval for Students: StampDAQ Excel

```
FOR  counter = 2 TO DATACOUNT  STEP 2

        READ counterT , result.LOWBYTE
        counterT = counterT + 1
        READ counterT, result.HIGHBYTE
        counterT = counterT + 1

        'DEBUG "Temp = ", DEC (result / 10), ".", DEC1 result , DegSym, " ", CR
SEROUT 16,84,["DATA,TIME,", DEC height, ",", DEC (result / 10), ",", DEC1 result, ","]

        height = height + 1
        READ CounterRH , result.LOWBYTE
        CounterRH = CounterRH + 1
        READ CounterRH, result.HIGHBYTE
        counterRH = counterRH + 1

        'DEBUG "Humidity =",  DEC (result / 10), ".", DEC1 result, "% " , CR, CR
        SEROUT 16,84,[DEC (result / 10), ",", DEC1 result, CR]
    NEXT
```

Trial#1 Data

Table 1. Trial 1 data taken on August 4, 4:30 PM at Atrium to Metrotech

Altitude	Temp	RH (%)	P (atm)	Comments
0	25.2	45.8	1.000	This data point was taken in the elevator on the first floor
0	24.5	64.2	1.000	
1	25	69.3	0.989	
2	25.1	69.5	0.977	
3	25.2	68.2	0.966	
4	25.2	68.3	0.955	
5	25.4	67.3	0.944	
6	25.5	66.5	0.934	
7	25.7	65.8	0.923	
8	26.1	64.4	0.913	
9	26.2	64.1	0.902	At this point the SMART Weather Balloon was very close to the ceiling, just about 1/2 m from it

Results and Conclusions

- The SMART Weather Balloon successfully captures T, RH, altitude, P_{bar} data from 0 to 9 m high.
- Variations in T, RH, and P_{bar} are obvious. T & RH data vary *randomly* - as expected
- Extend data collection to other spots at: 1m, 2m, 3m, etc from original position.
- Students then plot the isoline data

Future Work

- **Replace the meteorological balloon with a blimp that can hold a sufficient volume of helium to sustain the 235g payload.**
- Add on an additional gondola with three thruster-engine fans to allow for added up/down & lateral RC movement
- **Addition of transceiver chip to gondola and creation of another BS2 ground setup with a transceiver or receiver to capture real time data.**
- Use SMART Weather Balloon in the chemistry curriculum for gas laws, and in Physics for Force Balances (Static/Dynamic Equilibrium).
- **Contact Realtors: would aerial photos of homes be worth $$$?**

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SMART

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