OPENSOURCE WEATHER STATION 'ZEWS'

Harry Fultz Institute Open Source Club *HFI-OS*

Presentation prepared by Rei Prezja on behalf of the HFI-OS

Introducing Weather Station System

- Monitors the atmospheric conditions to provide weather forecast
- Estimates the average value of every data gathered
- Transfers the data into files that are compressed
- Stores the compressed files in DB Servers
- Forms a plot with the estimated values (in a days, weeks, months, years) for every atmospheric detail.
- Broadcasts the plot.

Introducing Weather Station System

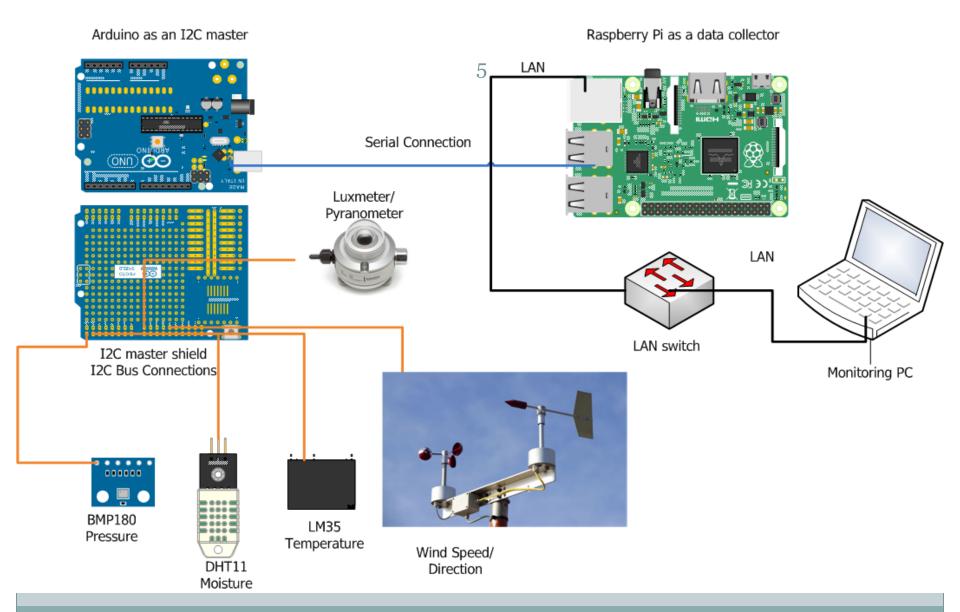
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Introduction

Main Components:

- Sensors (with Control Unit)
- Sensor HUB
- O Arduino I2C Master
- Raspberry Pi Data Collector
- IP Network (LAN)

Weather Station concept



Sensors





Anemometer



Lux-meter



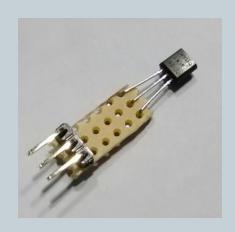
Barometer



Pyranometer



Hygrometer



Thermometer

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• Measures:

Wind Speed (in m/s)
Wind Direction (in deg rel to N)



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Module >> Mechanic :: Wind Speed and Direction









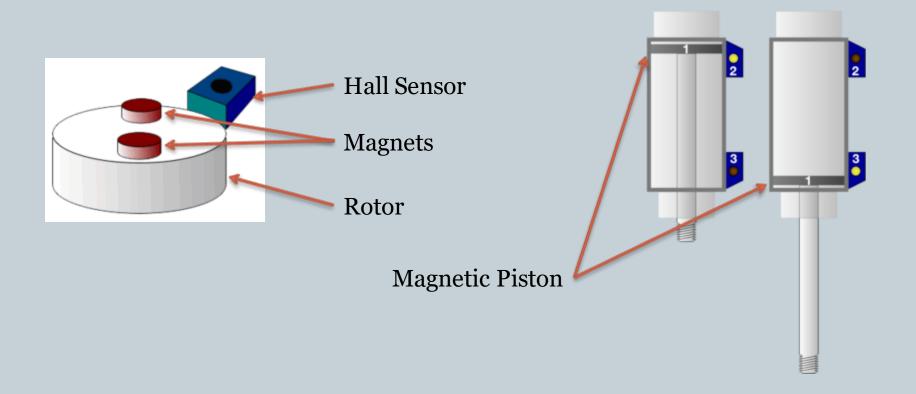
Wind Cups

Joint

Wind Direction Arrow

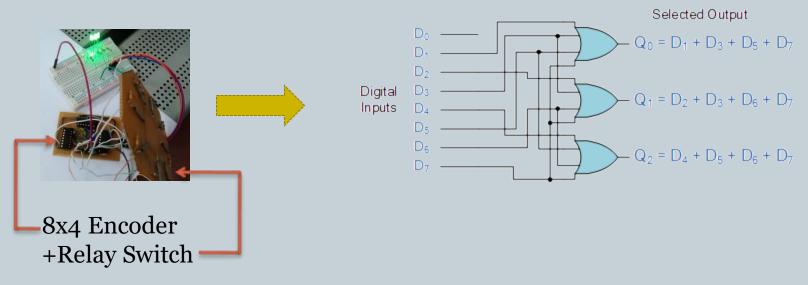
Low Friction Rotor

Module >> Electronic :: Hall Effect Sensor



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Module >> Electronic :: 8 to 3 Encoder



8 to 3 Encoder for Wind Direction



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Module >> Programming :: Wind Speed

- Wind Speed in [m/s] (meter per second)
 V=2πrf (where f-frequency in Hz)
- Wind Thrust
 F= m*v+(P-p)*A (where F Force in N)
- Terminal Velocity
 v=(2*P)/(ρ*μ*A)

Barometer

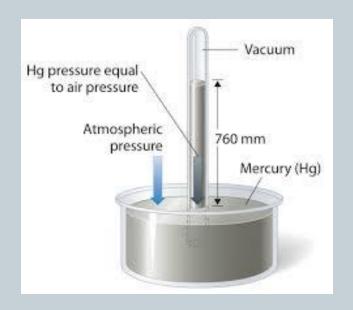
• Measures:

Atmospheric Pressure



Unit: hPa

(in Pa)



Unit: mmHg

Barometer

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Module >> Electronic :: Sensor

Barometer



Module >> Program :: Static Pressure

$$P(z) = P(z + dz) + \rho_a g dz \implies \frac{dP}{dz} = -\rho_a g$$

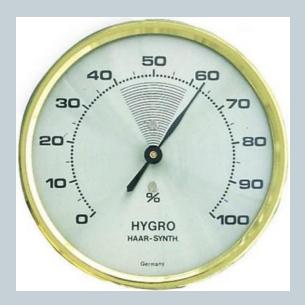
Module >> Program :: Barometric Law

$$P(z) = P(0)e^{-z/H}$$
 with scale height $H = \frac{RT}{M_a g} \approx 7.4 \text{ km} (T = 250 \text{ K})$

Hygrometer

• Measures:

Moisture



(in kg/m³ or kg/m³/°C or %)



HFI-OS

Hygrometer



Module >> Electronic :: Sensor



Hygrometer

Module >> Program :: Density (Specific Density)

•
$$\rho_{\rm m}$$
 = P/RT (1 - 0.378 e /P)

$$q_v = \frac{\rho_v}{\rho_{_m}}$$

Pyranometer & Luxmeter

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Measures:Solar LuminanceSolar Radiation

(in lx/m²) (in W/m²)



Pyranometer



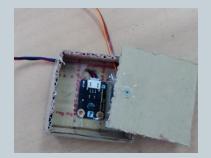
Lux-meter

Pyranometer & Luxmeter

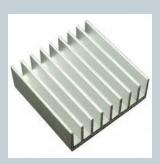
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Module >> Mechanic :: Temperature Controller

Pyranometer



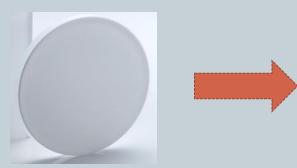
Container with Hatch



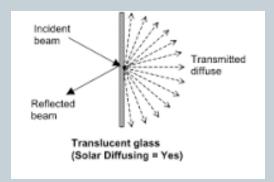
Heat Sink

Module >> Mechanic :: Light Diffusion

Lux meter



Translucent Glass

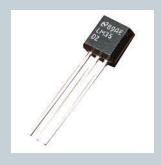


Light Diffusing Effect

Pyranometer & Luxmeter

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- Modules >> Electronic :: Solar Irradiation
- Modules >> Electronic :: Temperature Recalibration



LM35



Fan



LDR

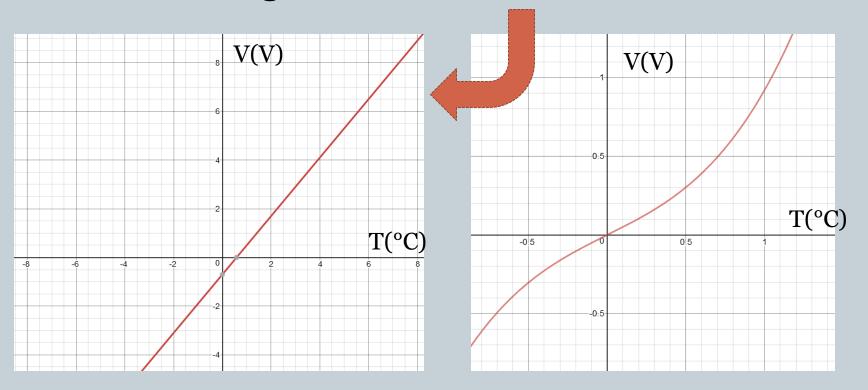


Servo

Pyranometer

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Module >> Program :: <u>Linear Data</u>

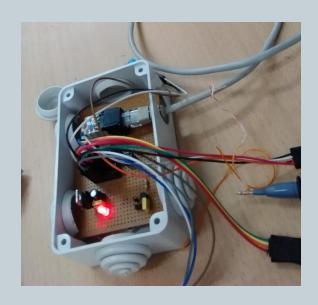


Linear Conversion

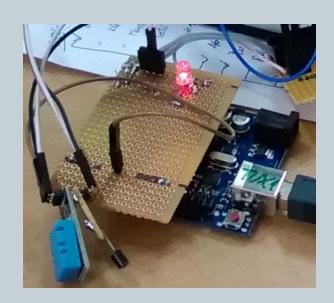
Nonlinear Conversion

Sensor HUB & Master Shield

• Module >> Electronic :: Sensor HUB and Master Shield



Sensor HUB



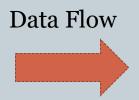
Master Shield

Arduino & RaspberryPi

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- Module >> Electronics :: Control Unit
- Module >> Electronics :: Processor Unit







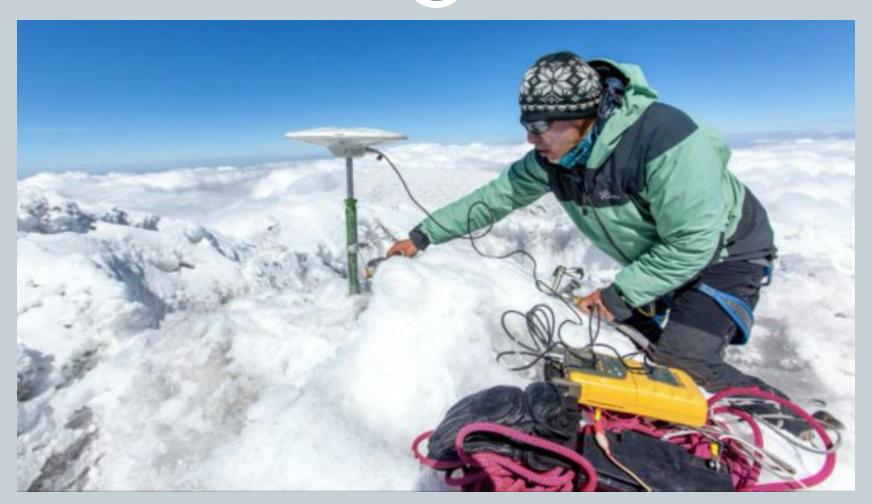
Arduino

Convert and Transfer Data

RaspberryPi Processing Unit Data Collection

Thank You!





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