University of Brighton
School of Engineering

Weather Station Assignment Report
EO106 – Electronic Engineering Practice

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1. Introduction

Project Brief:

'Research into all aspects of a weather station that your group may design, build and implement.'

Project Group members: (Tutor group EE1 B)

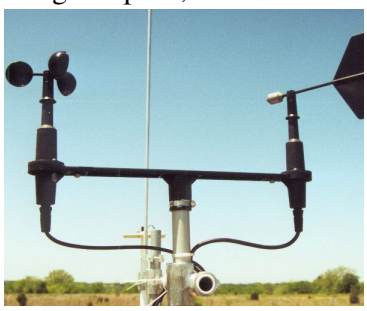
- Alexandros Gkatzogiannis
- Hesameddin Vafaei Nikakhtar
- Jassim Al Jaidah
- Andreas Barlos
- Saffron Balfour
- Georgios Psaroudakis
- Michael Curry

This project involves group research, with modules of the weather station unit being delegated amongst members. The purpose of the task is to get students used to working in a group environment, rather than focusing in any depth into creating a final product for use in the market. Nevertheless the research should include as much research, including detailed specification of the weather station. The final written report is to be handed in to the group's personal tutor, rather than going through the School of Engineering coursework submission system.

2. Wind speed (Alexandros Gkatzogiannis)

Several cups mounted on a pole (like below) will rotate, when a wind blows. By measuring the speed the pole is rotating, by calibration the current wind-speed can be calculated.

Common features for wind-speed measurement include maximum gust speed, and average wind-speed.



Range: 0.3 to 40m/s

Accuracy: ±3% or ±0.1m/s

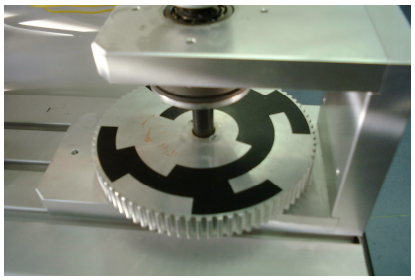
An precision of this percentage gives a maximum of a **9 bit** resolution on the Anaolgue to Digital (ADC) unit.

References:

http://weather.unisys.com/surface/sfc_con_wspd.html

www.energyquest.ca.gov/projects/anemometer.html

3. Wind Direction (Hesameddin Vafaei Nikakhtar)



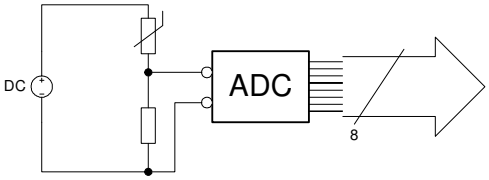
A disc (like shown) can be mounted underneath a weather vane (like above), with sensors detecting if each track is black (0) or white (1). Gray code must be used rather than binary, due to the nature of how the sensors detect the position of the weather-vane.

Accuracy: 3 bit (gray code)

Picture taken from

http://www.elektronikschule.de/~pusch/bke2000/ seite_7.html

4. Temperature (Jassim Al Jaidah)



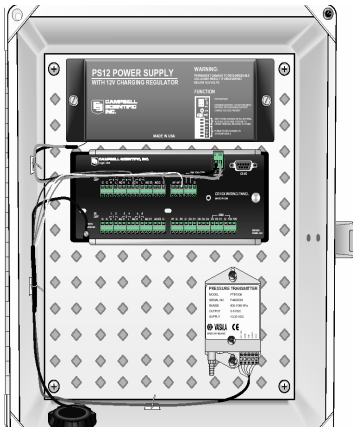
By using a thermistor (thermal resistor), a voltage divider circuit can be formed. A voltage can then be taken by an Analogue to Digital Converter (as shown) and converted into binary for processing in the weather station's CPU

Accuracy: -20 ºC to +60 ºC, 0.5º precision

This accuracy gives a maximum of **8 bit** resolution on the ADC unit.

No References Supplied (at this time 22/11/04)

5. Pressure (Andreas Barlos)



From ref. (2)

This module would use a pre-constructed barometer, such as the CS105 instrument (see reference below). This CS105 unit uses a Vaisala's Barocap silicon capacitor to sense pressure. This type of sensor does not use fluid, rather using the deflection from a diaphragm, which will change at different atmospheric pressures. This diaphragm will then vary the distance between itself and a nearby electrically capacitive plate.

'As atmospheric pressure increases, the distance between the diaphragm and plate decreases and the electrical capacitance increases.' (Quoted from reference 1)

Accuracy:

±0.5 mb @ 20 °C

±2 mb @ 0°C to +40°C

±4 mb @ -20°C to +60°C

±6 mb @ -40 °C to +60°C

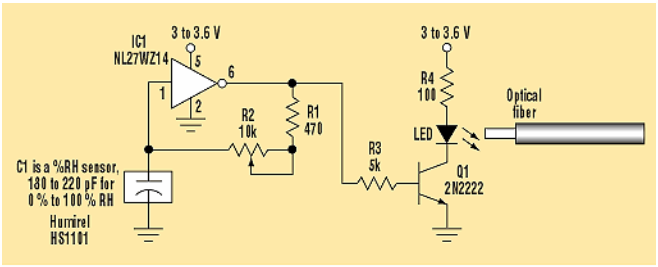
Range: 600 - 1060 mb

References:

(1) http://weather.austincollege.edu/ACWX_Measurements.html#Pressure

(2) http://weather.austincollege.edu/ACWX_Manuals/cs105.pdf

6. Humidity (Saffron Balfour)



Relative humidity over the range of 0% to 100% can be transmitted over optical fiber. This eliminates electrical data-transmission problems in humid cold-storage areas and greenhouses.

From reference (2)

Using a Humidity sensor such as the HS1101, a circuit such as this (←) can be set up. This allows the variable capacitor to create a signal down the fibre-optic cable. However, for the purposes of this weather station, an optical link would not be necessary, therefore a slightly different end would need to be researched into, to connect up to the weather station's CPU

Range: 0-100% Humidity

Accuracy: ±3% ➔ 5bit ADC

References:

(1) http://www.national.com/an/AN/AN-256.pdf

(2) http://www.elecdesign.com/Articles/Index.cfm?ArticleID=1684

7. Rainfall (Georgios Psaroudakis)

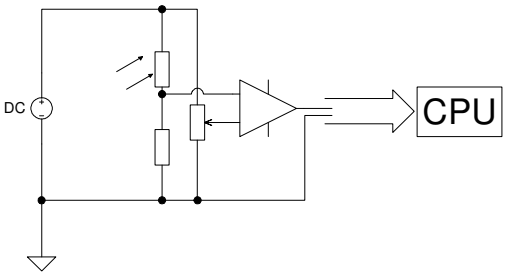
Principles of Operation

Picture taken from reference (1)

The 8" diameter funnel directs rainwater into a "tipping bucket", which is divided vertically into two halves. When 0.01" of rainfall fills one side of the bucket, the bucket tips, spilling the water through the bottom of the rain gauge. The other side of the bucket is then positioned under the funnel. The bucket alternates tips with each 0.01" of rainfall. With each tip, a magnet, mounted to the bucket, activates a sealed, magnetic reed (proximity) switch, producing a momentary contact closure. When connected to the American Sigma Storm Water Monitoring System, the number of bucket tips may be used to initiate sampling. When used with the Rain Logger™, in a stand-alone state, the number of bucket tips, representing 0.01" of rainfall, is recorded in user selectable time intervals of 1, 2, 3, 5, or 10 minutes. Data storage capacity is 10,080 readings.

Accuracy: **0.5% at 0.5" per hour**
Resolution: **0.01" rainfall per bucket tip**
References:
(1) www.americansigma.com/products/rainfall/cfm

8. Sunshine Hours (Michael Curry)



'Sunshine is detected by a PIN diode operating in photovoltaic mode. The signal from the diode is amplified and passed to an analogue to digital converter. The digital signal produced is then used by the microprocessor to determine sunrise and sunset time and also to measure sunshine hours.
Sunrise and sunset are measured to an accuracy of +/- 15 minutes.' [Quoted from (1)]

Using a PIN diode would not be very accurate, so by using a Light Dependant Resistor (LDR) in an OP-amp comparator circuit, the unit can be carefully calibrated. The position of the weather station unit is vital for the correct functionality for this unit as if the LDR is cast into shadow, the 'beginning/end of sunshine hours' threshold cannot be set, or when the is in a certain position in the sky the unit would assume darkness, as the sensor would be in shade. However, through careful calibration on a prototype in the field, results will give a better idea for the accuracy for this module.

Accuracy: **±5 minutes** for total sunshine hours for the day (rough estimate)

References:
(1) http://www.leekhigh.staffs.sch.uk/weather/tech.html