Weather Station Review

Graham Cox & Carlos Perez

August 3, 2006

1 Introduction

A review of the weather station has been carried out with the following two options considered; upgrade the existing weather station or purchase a new one. The existing station has proved reliable with the main problems been associated with ice in winter freezing the mechanical parts and even breaking them off and the occasional false rain alarm. We are missing some spares for the station, these include some sensors and electronics. Purchasing a new station is considered because it would be of similar cost to bringing the existing one up to date, and having two could improve the reliability even more.

By using RS232 to Ethernet converters it would be possible to use the webcam Internet optical fibre for communication though this then would mean a change to the TCS for the method of accessing the data, and reliance on the Internet for weather information.

2 The Weather Station

The existing weather station consists of several meteorological sensors, these are: an anemometer (wind speed), wind direction sensor, barometer, rain sensor, humidity sensor and a temperature sensor. The main problems we've had with the station are due to ice in winter that frequently breaks both the anemometer, wind direction sensor or causes them to stop working for periods of time. Also the rain sensor has given false reading occasionally usually due to birds and we have had the communication link (a 20mA current loop) fail due to lightening.

All the sensors are commercial produces but the mechanical construction and all the electronics and software were developed in house. The basic principle of the station is that the sensors give various signals representing the specific measurement and these are converted using boards called WS1-1 and WS1-2 to voltage levels that are read by a computer board (WS2) and transmitted in a package to the TCS along the 20mA serial current loop galvanic line. The code for the computer sits in a PROM on the CPU board and we have no copy of this code or any way of easily generating it. Also the board is old.

We have spares for some sensors but not for anemometer, wind direction sensor or barometric pressure sensor. The spare computer board WS2 is without the correct PROM (software) and the spare rain sensor is of an older type so less reliable (more false readings). As for the WS1-x boards we only have empty printed circuit boards and due to modifications and upgrades of some sensors these boards are not necessarily used. Also we don't have a development package to support the microprocessor on the computer board.

To bring the weather station up to date it is proposed that we obtain spares of the missing sensors, replace the computer board with a more modern one that we can support, rewrite the software and build new versions of the WS1-1 and WS1-2 boards to make them

compatible with the new computer board and sensors. A new computer board has been identified that uses a 68HC08 micro-controller [1] which is the same family as the instrument motor controllers use, though a different version, and a development board [2] would be purchased with the CPU on so no computer board designing would be required, only up-grading the WS1-x boards. A free development tool [3] has already been obtained for this micro-controller.

The old 20mA current loop is suggested to be replaced by using the web-camera optical fibre. This will require that a RS232 to Ethernet module (as used on NOTCam and Fapol) and a hub be installed so the weather station and webcam can share the fibre. An important consideration is that a change from the dedicated serial line to Ethernet will require modifications to the TCS code and also means we will be reliant on the Internet for weather information.

Typical prices for the sensors are around €600 each, the CPU development board is about €170. Typical costs to get new WS1-x board made would be in the order of €400 each. In addition the time to develop new code would probably be a few months including the learning curve for the develop tools.

None of the proposed up-grades will solve the problems of ice in winter.

3 Alternative Weather Station

As an alternative to up-grading the old weather station is to purchase a complete new system and one has been identified made by Vaisala in Finland. The Vaisala weather station is called WXT510 Weather Transmitter [4] and essentially does the same as our existing station but with one significant difference it doesn't use the old style rotating anemometer and swinging weather cock but uses a novel system of three fixed ultrasonic transducers that transmit sound waves to monitor both wind direction and speed. The physical size of the instrument is diameter 120mm by 240mm high and the price is €2690 + IVA.

Table 1: Basic Specification of the Unit

wind speed range	0 - 60m/s at ±0.3m/s or ±2%, which ever greater
Wind direction	0 - 360°, 1° resolution
Rainfall	0.01mm resolution, droplet detection
Barometric Pressure	600 - 1100 hPa, ±0.5hPa
Air Temperature	-52 - +60°C, ±0.3°C
Humidity	0 - 100%RH, ±3%RH 0 - 90%, ±5%RH 90 - 100%

This weather station comes with an optional heater that should prevent freezing and ice build-up. The only problems envisaged with the WXT510 is possibly spiders making webs inside the three ultrasonic transducers so effecting the wind measurements, bird droppings and its ability to measure accurately individual rain drops, though the specification states it is capable of doing the latter. Using the rain intensity measurement gives 0 if no rain, otherwise it is raining

The only maintenance specified are cleaning the transmitter when necessary and replacing the so-called PTU module (for barometric pressure, temperature and humidity measurement). It is recommended to calibrate the PTU module every two years.

Extra items we would need to supply are two power supplies, one for the heater and the other for the electronics, and a RS232 to Ethernet converter and hub to use the webcam optical fibre. These will be housed in a separate weather proof heated box next to the weather station.

4 Two Weather Stations

By converting the RS232 signals from the existing weather station and the suggested new one to Ethernet it would be possible to run them in parallel over the same Internet fibre with the webcam. We would then have some redundancy regarding sensors with two simultaneous measurements possible of all the meteorological parameters so improving the reliability of the readings.

If the Vaisala weather station proved to be reliable we could then consider purchasing a second one and placing it nearer or even inside the telescope dome.

5 Access to Weather Station

If changes to the weather station are to take place this would be a desirable opportunity to improve the access to the station by building some steps and a handrail. The steps could simply be something cut into the rock rather than paved. This would increase the safety and be particularly useful since it is typical that the only time you need to go up to the station is during bad weather to either repair it or clear ice and snow.

6 Recommendations

Improve access to the weather station by building some steps, if formal Medio Ambiente permission is not required.

Purchase a Vaisala weather station WXT510 and operate it in parallel with the existing one. This should be done in stages, first install and put the new one on line, then get the TCS to be able to read this new data. Once this is done then work can be carried out on the old one. The main task is to put it on the network but also improvements can be implemented like attempting to make a backup of its PROM based software and then maybe up-grade the computer board and code to a level we can support. The galvanic serial line from the exist weather station should be disconnected from the TCS, though not removed for now.

Changing to Ethernet communication will mean we will be reliant on the Internet for weather information and as a consequence the safety of the telescope.

References

[1] Freescale 68HC908GP32 8-bit micro-controller
www.freescale.com/webapp/sps/site/prod_summary.jsp?code=68HC908GP32&srch=1

[2] Freescale, M68EVB908GP12 Evaluation Board
www.freescale.com/webapp/sps/site/prod_summary.jsp?code=M68EVB908GP32

[3] Freescale, CodeWarrior for HC(S)08/RS08 and HC(S)12 Special Edition Tri-Pak
www.freescale.com/webapp/sps/site/prod_summary.jsp?code=CWX-HXX-SE&srch=1

[4] Vaisala, *www.vaisala.com/businessareas/instruments/products/weathermulti-sensor*