METEOROLOGICAL UNIT FOR DIDACTIC USES (UMUD)

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ABSTRACT

The most important intention of the didactic meteorological unit is to give a support for the students to obtain an general view of their environment as a set of systems, and to understand the relationship among them, as well as to make some kind of forecasting. This meteorological unit is integrated with national components that make it very low in cost, and easy to maintain since all the mechanical parts are national likewise, and the electronic components can be obtained easily in the national market.

RESUMEN

El propósito fundamental de esta unidad meteorológica didáctica es proporcionar un apoyo para que el estudiante obtenga una visión del ambiente que habita como un conjunto de sistemas, de tal manera que sea capaz de describir la relación que existe entre ellos para que, hasta cierto punto, pueda predecir sucesos climáticos. Esta unidad meteorológica esta integrada con componentes nacionales lo cual la hacen muy económica, su mantenimiento es de fácil realización ya que todas las partes mecánicas son de construcción nacional al igual que los componentes electrónicos se pueden conseguir en el mercado fácilmente.

KEYWORDS: Meteorology, Sensor, Instrument.

1. INTRODUCTION

For the understanding of the subsystems that integrate the troposphere (Pluvial system, cloud system, ...) and their relationship, the appropriate handling of fundamental concepts its required. These subsystems will be understood better by carrying out measures of environmental conditions and analyzing its interrelation. For a better understanding of our environment it is necessary to carry out some field practices and develop some activities, for which the meteorological unit will be of great help.

2. SCB DEVELOPMENT

Because the purpose of this unit is only for didactic use, seven variables (the most common) were considered, from that are used in the most meteorological commercial units Each one of then is described as follow.

2.1 Wind speed

To detect this variable you have to design an anemometer of vertical axis of rotation. The sensor used is one with an optical-switch grooved, which can be obtained in the national market. The output of the sensor has an square sign of 37 pulses for each turn, that implies the design of a frequency multiplier circuit for a better register of the speed of the wind; later this signal is applied to a special circuit, that makes a conversion from frequency to voltage. The converter provides an output that can vary from zero to five volts, this level of voltage is conditioned later by means of an analogical converter to a seven segments output, or it can be read by means of a computer using the output port (figure 1).

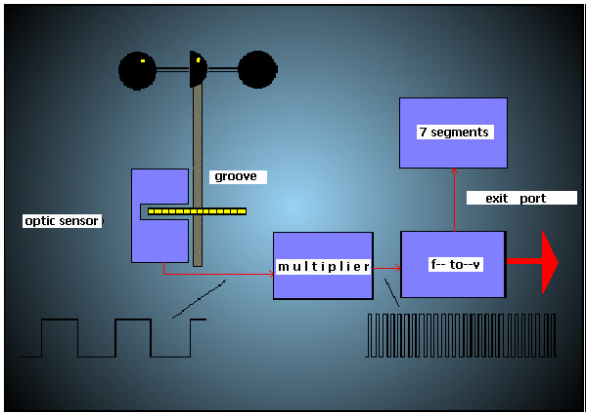


Figure 1. Anemometer

2.2 Wind direction

This part of the meteorological unit is able to indicate the direction of the wind. It is expressed in grades clockwise from the north. This variable, as that of the previous point, is very important because it allows to register the form in which the pollutants are dispersed in big cities. The sensor consists of two variables and lineal resistances without limits, which are connected in such a way that they cover 360 degrees in which the wind direction can vary. This signal is converted to a voltage level between zero and five volts and it is presented in form of degrees by means of a digital screen of seven segments (figure 2).

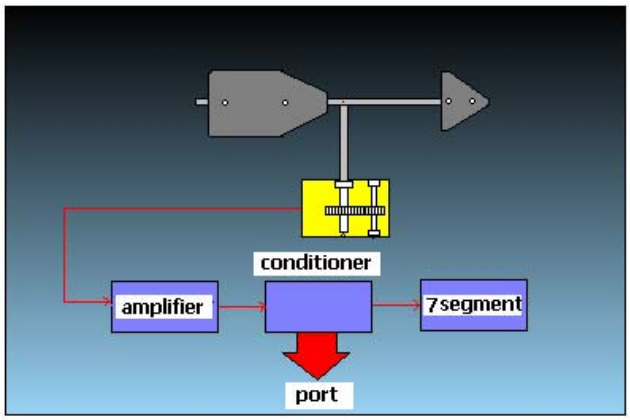


Figure 2. Diagram of the vane

2.3 Relative humidity

It is measured using a hygrometer. The relative humidity (RH) is the percentage of the pressure of saturation vapor that represents the pressure of real vapor, therefore it is the ratio between the current quantity of humidity in the atmosphere and the maximum humidity that the atmosphere can have. The value changes between zero and one, and frequently it is given in percentage. To obtain this value, a sensor of relative humidity is used. The sensor was easily gotten in our national market (figure 3). It is built with integrated- circuit [1] with a polymer which changes its properties with the humidity and presents a lineal output of voltage that is proportional to % of RH (figure 4). The sensor is very accurate and of quick answer. The hygrometer has an accuracy of ± 2%, full scale, with a voltage supply of 5 (v) and the linearity of ± 0.5 % typical.

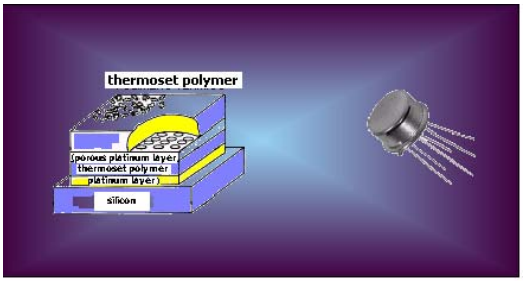
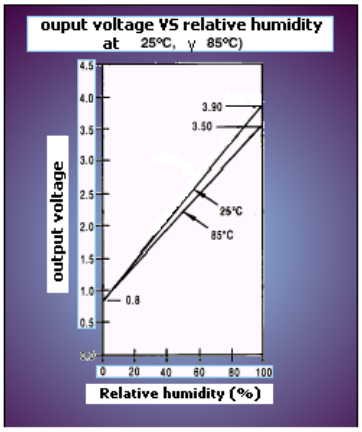


Figure 3. Sensor of relative humidity



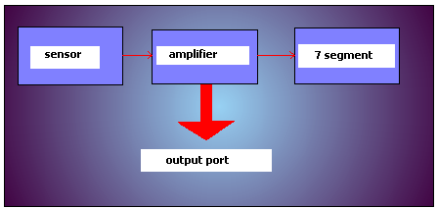


Figure 4. Block Diagrams of the hygrometer and output voltage when varying % RH

2.4 Temperature

The thermometers of the proposed meteorological unit, must be placed in protected open spaces away from sun and rain, and without obstructions to the air flow. They must be placed in a place where the conditions of the site are typical, so that the measures are representative. It had a sensor that provides values of temperature at both, in the sunshade and in the open (internal and external). The sensor element is an integrated circuit which can work in the interval from (-40 to 110) °C and it has a typical accuracy of ± 1°C.

The output of this element is amplified and later is connected to a digital analogical converter circuit with an output of luminous elements of seven segments, this signal is available to be read by a computer, if it is required. With the computer we can register any variations of the temperature during the day, setting the maximum temperature which can be taken between the 14:00 and the 16:00 hours, and the minimum temperature at morning time before the sunrise. With these two daily data could be calculated the average temperature of the day.

2.5 Solar radiation

The instrument that measures the solar radiation is generically denominated radiometer [3]. The sensor element for this subsystem is a photo-cell which responds to the visible region and the near-infrared region emitted by the sun. This parameter is an indicative of the clarity of the air, since the level of radiation received by the equipment, depends as well from smog, smoke, dust and clouds. In the case of the meteorological unit the sensor have to measure the intensity of diffuse solar radiation of the sky, for that a solar diffuser is placed with a translucent plastic and the cell is inserted in an opaque packing. After it is placed, is sealed with a drying agent resin so that the photo-cell is never wet. The signal that is obtained has not a lineal relationship whit the data and to gauge the radiometer it was necessary to use a radiation meter equipment (table I). The signal obtained from the sensor is amplified and

conditioned for a later presentation in a digital screen of seven segments . There is also the option of sending data using the output port, to be processed by a computer.

Table I

White fluorescent lamp of 40 W		Incandescent lamp of 100 W	
Radiant energy W/m2	Distance	Radiant energy W/m2	Distance
0.3	2.9	0.3	4.2
3	0.99	0.9	2.4

With data of this type it is possible to gauge the radiometer and finally build curves of daily radiation as the ones shown in figure 5.

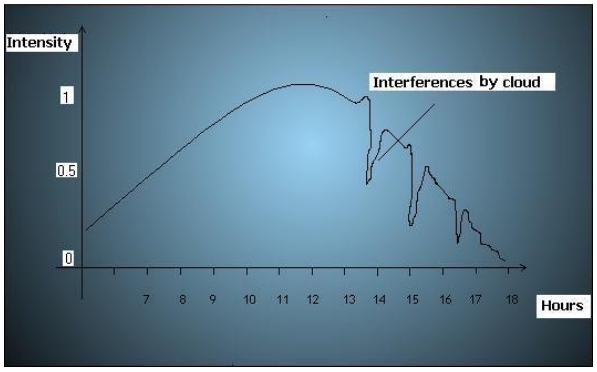


Figure 5. Typical curves of solar radiation

2.6 Barometric pressure

This pressure, although does not have to change by other factors, but the altitude above sea level, could be changed when some variables of the meteorological conditions are changed. For this reason it is important to measure it.

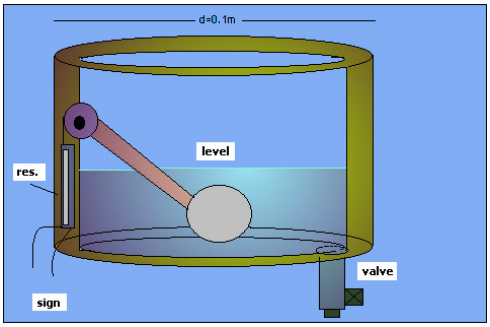
The element used is a commercial pressure sensor that can be easily obtained in the national market. Its characteristics are shown in table II.

Table II

Sign	not amplified
Operation range	0-29 PSI
Pressure max.	58 PSI
Voltage supply	10-16 VDC
Span	38.5 mV MIN.
	40mv TIP.
	41.5mV MAX.
Sensibility	0.2 mV /kPA

2.7 Precipitation

The precipitation could be measured on the base of a vertical column of water [3] that is accumulated in a open recipient with square meter dimensions. As it is known, in the metric system the precipitation is measured in *mm* and tenth of *mm*. The meteorological unit has an equipment of floated type (figure 6). The level is registered by means of a lineal variable resistance which changes its value when the liquid being accumulated goes up in the recipient, later this resistance value is converted to a voltage signal and it is shown in *mm* of water.



Figures 6. Mechanism of pluviometer

3. CONCLUSIONS

An important aspect of this Unit is that it is integrated with national components that makes it very low in cost, in comparison with those manufactured by foreign companies. Also, their maintenance can be carried out easily since the mechanical parts are of national construction.

4. REFERENCES

[1] Burr-Brown Corporation, Integrated Circuits, Data Book, volume 33, 1989.
[2] Pspice, release 8 ., software for circuits simulation
[3] Norton H. N. Sensor and Analyzer Handbook, Cap .I, II, III ed. Gustavo Gili , 1982

Authors Biography

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Was born in Mexico City, in 1963. He received the title of Mechanical Electrician Engineer from the National Autonomous University of Mexico, in 1990. He joined the Center of Applied Sciences and Technologic Development in 1991, where he has been member of the Laboratory of Electronics since 1999. His current research interests are microcontroller based systems, programmable logic, and instrumentation.

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