Playing with THEREMINO: My first VB APP
(Theremino_LM35_Thermometer v. 1.2 – with Relay control)

After becoming acquainted with the system Theremino (www.theremino.com) and precisely with the fundamental application HAL, I wanted to experience the realization of a first "Thereminic" APP, dusting off my old knowledge of Visual Basic.

I must say that this is NOT a "Flashing LED": we have seen too many of them into other starting examples of well known microcontrollers!

I thought of a low-cost precision thermometer (now with Relay Output control !) to connect to my PC. The base of the project is Theremino Master, a simple and powerful device that allows the connection of a large variety of analog sensors to a PC. The sensor I choose is well known LM35. To buy everything, including Theremino Master card, you spend 12 Euros or so.

The sensor LM35 is the heart of our thermometer and I'll describe it later. A raw "calibration" can be made through the NumericBox you see in the above screen dump of control software.

This "adjustment" is useful to achieve greater precision. You can get if you have the opportunity to compare the measures of LM35 sensor with a high accuracy reference thermometer.

 In practice the software "adds" the value in the box to the reading coming from LM35: in this way we can adjust the temperature within an interval of +/- 0,999 °C.

VISUAL BASIC Programming

With Visual Basic, you can do *Object Oriented Programming* , creating the FORM (ie the application's "Window") and populating it with *objects*, ie buttons, text fields, labels, etc.

Each *object* that belongs to a FORM has it own's PROPERTIES , and the programmer can

customize them. The "Properties" can be considered as "variables" and can be modified both in the preparatory phase, into the Visual Basic Application, or by suitable commands when the software is running.

Anyway I suppose you are a little familiar with Visual Basic programming, otherwise you have to learn a bit of it through Microsoft Knowledge Base or other sources. VB 2008 Express is a suitable version to develop little Windows Apps working with Theremino modules.
(See: http://www.theremino.com/downloads/notes-on-software#instruments)

HARDWARE and HAL

We need very little hardware to build this project and connect it to the PC. One Theremino MASTER (see the detailed description on the Theremino.com site, in the "Foundations" section) and a LM35 (search E-Bay, for example). NO other components are needed.

Properly connect LM35 to the MASTER as described in this link:

(http://www.theremino.com/hardware/inputs/meteorology-sensors)
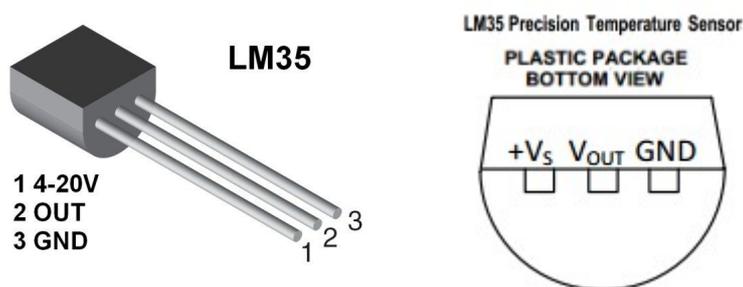
+Vs =+ Vcc (+5 V),   Vout is the "Signal"

   If you want to connect a relay, please read this section on Theremino's Site and build your preferred little hardware which is necessary to connect a thermic Load to the controller (watch the sub-section: "A simple driver for Relays" and following).

Remember that in Theremino MASTER the word "PIN" refers actually to a group of three "pins", which are signal (SIG), Positive supply (+ 5V), Ground (GND). The purpose of each "triple" pin is to offer great convenience to those who connect their hardware to the card, since you have always available a +Vcc and a ground close to the signal. Thanks Theremino!

This is how to connect Theremino Master and LM35 (going with cables from LM35 to Theremino, remember to swap two of the three pins according the following note):

```
LM35                  Theremino
                      PIN (1)
(4-20V)  ----------   (1) +5V (the Central one of three 'pins')
(OUT)  -------------  (1) SIG (the upper one)
(GND) --------------  (1) GND (the lower one)
```

The sensor LM35 is 'analog type' and it has a direct relationship between voltage and degrees celsius: +/- 10mV = +/- 1 ° C. The sensor, whithout adding other components, works only for temperatures above zero and reaches up to a maximum of 150 ° C (see the datasheet).

Remember that ADC pins of Theremino work from 0 to 3.3 V (maximum input). If within the program HAL imposed the SLOT1 with limits from 0 to 330, I will read directly the

temperature value in Celsius scale. In our project we associate for example the SLOT4 to Pin 4 of the Master Card and we leave unchanged the default slot values (0, 1000): the software will take care of the calculations!

HAL and VISUAL BASIC EXPRESS 2008

HAL (Hardware Abstraction Layer) is an excellent link between hardware and software.
The program HAL.EXE must be enabled to operate Theremino MASTER and sensors connected to it.
HAL.EXE can be downloaded from Theremino.com
The HAL dialog window can be minimized , making room on the screen for a specific application like our LM35 thermometer software.
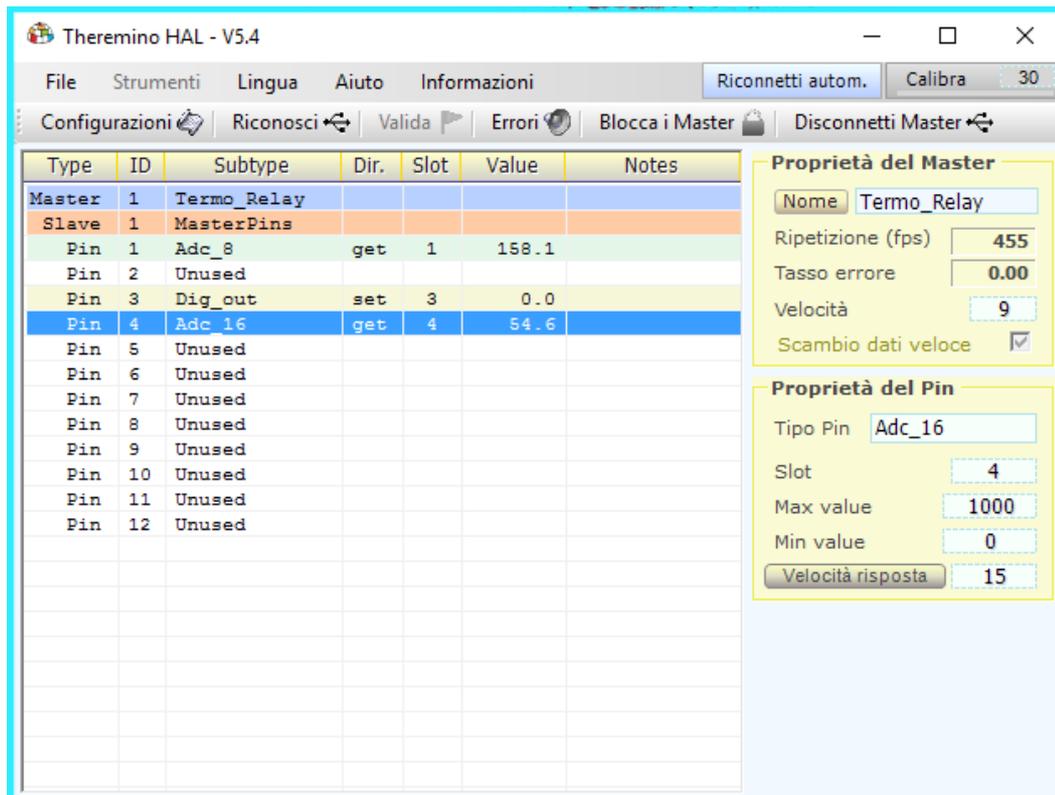
The Theremino HAL window

The Theremino TempController App.

This specific APP, written in Visual Basic 2008, was fully recovered from a basic application example called "Empty Theremino App": you can find it on Theremino.com site at this link:

http://www.theremino.com/downloads/notes-on-software

This "empty" application already contains a very important *class* of functions that allows us to read and write in a Slot of the Theremino Master, using the software HAL. Do not use directly the above mentionedapplication: it must of course be adapted to read the LM35.

Please refer to some comments that you'll find inside the modified application to have an idea of how it works!
The following is a screenshot of the working application:

Theremino LM35 Thermometer with Relay control
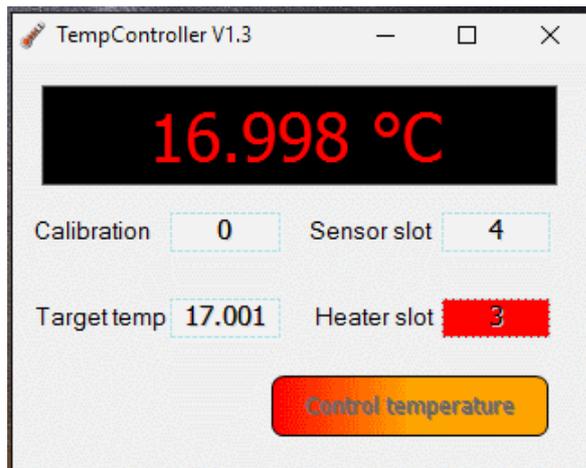
you can see four "TextBox", and you can change their value according to your needs: these boxes are "user friendly" and you can change them also by dragging mouse up and down while keeping pressed the left button, or use mouse wheel over them, as you prefer.

- – "Calibration": you can enter a small Delta-Temerature value to add (with its sign) to the LM35 reading;
- – "Sensor slot": It is the slot where you connect LM35: in HAL remember to set it as "Adc_16";
- – "Target temp": in °C . Below it the heater turns on by setting to "High" the Heater slot's state;
- – "Heater slot": here you connect the relay by using methods described here. Red background means the relay is on (Also remember to properly configure this slot into HAL as "DIG_OUT"

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A final important note to my account: after spending two or three years into using different microcontroller Ard..... or so, with interfaces very "raw" or proprietary and separated compiler/programming environments (not so user-friendly), I could finally look at Theremino System like a valid combination of hardware and software, both being really HQ open source products! .