EDUCATION EXPERIENCES WITH A USB INTERFACE

© József NEMES
(University of West-Hungary, Szombathely, Hungary)

njozsef@ttmk.nyme.hu

On the basis of experiences so far, it can be stated that both software and hardware knowledge can be presented well by using the interface. With the eight digital outputs, five digital inputs, two analog inputs, two analog outputs and the two PWM outputs, all of the basic problems of control can be presented properly that we may encounter in an industrial environment like flexible production. By connecting various sensors and effectors and with relatively little hardware knowledge, spectacular measurements and controls can be constructed. Last but not least, it is essential that students and learners can experience the advantages of programmed controlling as opposed to wire controlling, with relatively simple programming tasks.

Keywords: control technique, informatics

USB Interface Experiment Board Electronic Kit

The USB interface board kit K8055 has 5 digital input channels and 8 digital output channels. In addition, there are two analogue inputs and two analogue outputs with 8 bit resolution. You may write custom Windows (98SE, 2000, Me, XP) applications in Delphi, Visual Basic, C++ Builder or any other 32-bit Windows application development tool that supports calls to a DLL.

USB Interface Experiment Board Features:

- *System requirements*:
  - Pentium class CPU
  - USB1.0 or higher connection
  - Windows 98SE or higher (Win NT excluded)
  - CD ROM player and mouse.
- *Diagnostic / Test Software*:
  - separate output / input test
  - clear all / set all function
  - analogue output set sliders
  - counter function on inputs 1 and 2 with adjustable debounce (max 2kHz depends on total I/O load)
- minimum system requirements:
  - Pentium class CPU, USB1.0 or higher connection
  - Windows 98SE or higher (Win NT excluded).

USB Interface Experiment Board Specifications:

- 5 digital inputs (0= ground, 1= open) (on board test buttons provided)
- 2 analog inputs with attenuation and amplification option (internal test +5V provided)

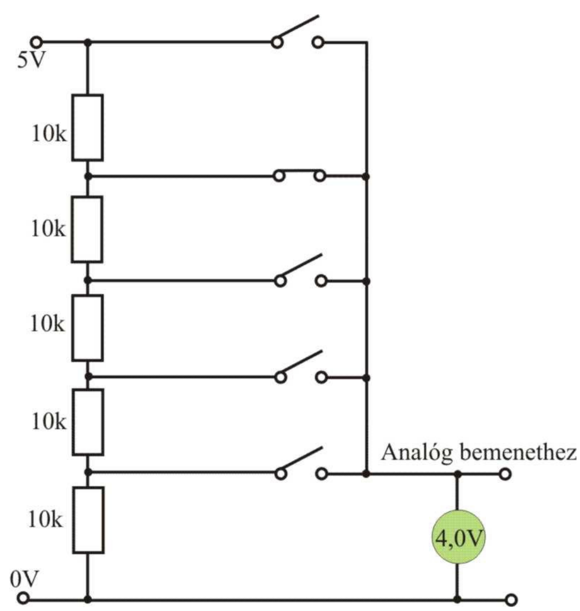
- 8 digital open collector output switches (max. 50V/100mA) (on board LED indication)
- 2 analogy outputs:
  - 0 to 5V, output resistance 1K5
  - PWM 0 to 100% open collector outputs max 100mA / 40V (on board LED indication)
- general conversion time: 20ms per command
- power supply through USB: approx. 70mA
- diagnostic software with DLL included.

Analogue inputs

Now I would like to present an example which not only adapts bi-state signals to the computer but also processes analog signals. First, let me summarize in a few words what the problems of joining an analog input to the computer through an interface are.

With every analog input, an external power supply of no more than 5V should be used, but the 4.5V "flat battery for torches" will do as well. With a zero input voltage we will read the value 0, and with the maximum voltage the converted value will be 255. With this, we can demonstrate the principle of analog-digital conversion from 0 to 5 Volts. With the help of an internal – testing – voltage, we can simulate an analog input, with ATT1 and ATT2 potentiometers. If you wish to use that, you must close the SK2 and SK3 jumpers, so that the internal power supply of 5V is at your disposal. If R1 is LDR and R2 is a constant-value resistor, then the read value of the input will change together with the decreasing of illumination. This is the principle of a humble light meter.

Figure 1. Analog-digital converter

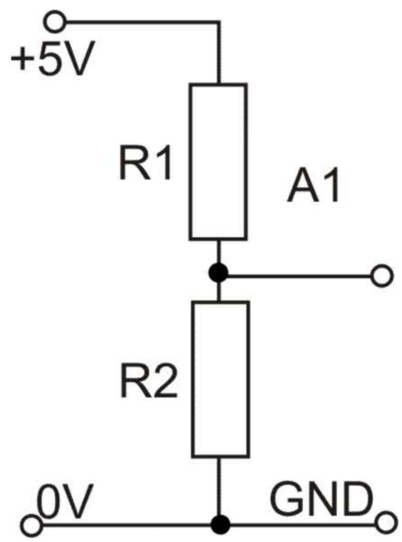


The figure shows the circuit diagram of an appropriate analog-digital converter. (see *Fig.1.*) We mount reed contact pins along the "long edge" of the A/D converter at equal distances. When a suitable magnetic object approaches the contact pin, the chain of resistors will create a given voltage on the input of the interface. This binary value falls between 0 and 255.

Measuring light

The analog inputs are used according to the principle of the voltage-divider, and it will help us build simple measuring devices, such as equipment for measuring temperature and light. (see *Fig. 2.*)

Figure 2. Voltage divider



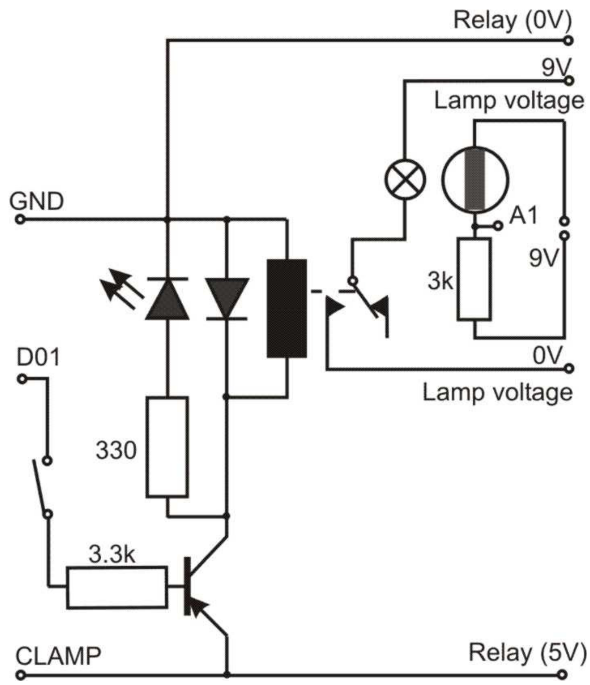
To build the switching panel, you will need the following major components:

- a relay, which is driven by an external power supply of approx. 4.5V for the interface, and is controlled by D01 output of the interface.
- a LDR-resistor, for the analog input (e.g. A1) set to close, which is also driven by an external power supply of 4.5V.
- a light bulb or LED, also with an external power supply, direct or alternating current, and with galvanic detach from the interface.

In the mechanic implementation it is advisable to choose such a method where the light bulb and the LDR are built into one closed case, such as a film roll case, which prevents the LDR from getting stray light.

For measuring the illumination of a room you will need 1 LDR ->R1, 1 constant resistor of about 330 Ω ->R2, 1 battery or a power supply of 9V direct current.

Figure 3. Circuit of the light meter



R1, the LDR is the active resistor, whose resistance value is about 18Ω at approx. 5cm from a 60W light bulb. With "normal" illumination its resistance is 180Ω, and in darkness it is several kΩ.

The R2 resistor is a metal layer 330Ohm resistor. The switching is a voltage divider, which will cause a drop of voltage on both resistors. When using a new battery, the voltage is about 4.8V. On the R2 resistor, the voltage will be:

$$U_2 = \frac{R_2}{R_1 + R_2} \cdot U_T \qquad (1)$$

$$Value = \frac{U_2}{U_T} \cdot 255 \qquad (2)$$

The measured values with different illumination are contained by Table 1. In practice, the results may differ, for example, we have ignored the input resistance of the inputs. In addition, the value of 255 may not be reached in the case of a 4.8V analog output. It must also be made clear that the amperage that transits the LDR resistor will change to a minimal extent. In order to get an even change of the value to be indicated, the change of illumination should be compared to the values measured by a precision light meter. To read the data and insert them in an Excel cell, you will need the following simple program fragment. (see *Table 1.*)

```
Sub A_In_Click()
Dim number As Long, value As Byte
   number = Cells(1, 14)
   value = InpA(number)        (2)
   Cells(5, 14) = value
End Sub.
```

Table 1. Max. light intensity

	Resistance	Voltage	Value
Battery		4,8	
LDR	20	0,25	13
Constant Resistance	330	4,55	242
R-sum.	350		255

Table 2. Stray light measuring

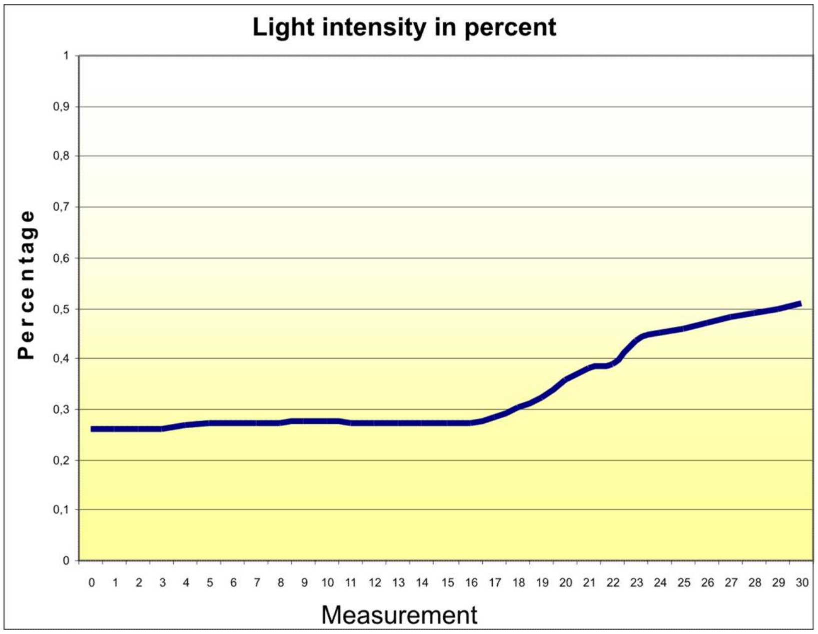
	Resistance	Voltage	Value
Battery		4,8	
LDR	170	1,59	90
Constant Resistance	340	3,21	165
R-sum.	510		255

Table 3. Weak lighting

	Resistance	Voltage	Value
Battery		4,8	
LDR	2900	4,12	220
Constant Resistance	430	0,68	35
R-sum.	3330		255

If you insert the changing values of a VDR connected to an analog input into an Excel table, give the sampling frequency and the maximum number of measurements with one sampling, then you can even store the actual values, and use a diagram to show the changing of luminosity (see *Fig. 4.*) Of course, the program mentioned above is not capable of providing this service, but within these frames there is no opportunity to include a longer list of programs.

Figure 4. Changes of luminosity



As a final conclusion, it can be stated that a given interface provides an opportunity to be able to demonstrate the industrial models of computerized controlling technology in the various fields of education, by using relatively simple switching technology programming knowledge.