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# APPLICATION NOTE No. 011

**Direct or remote management of digital inputs/outputs**

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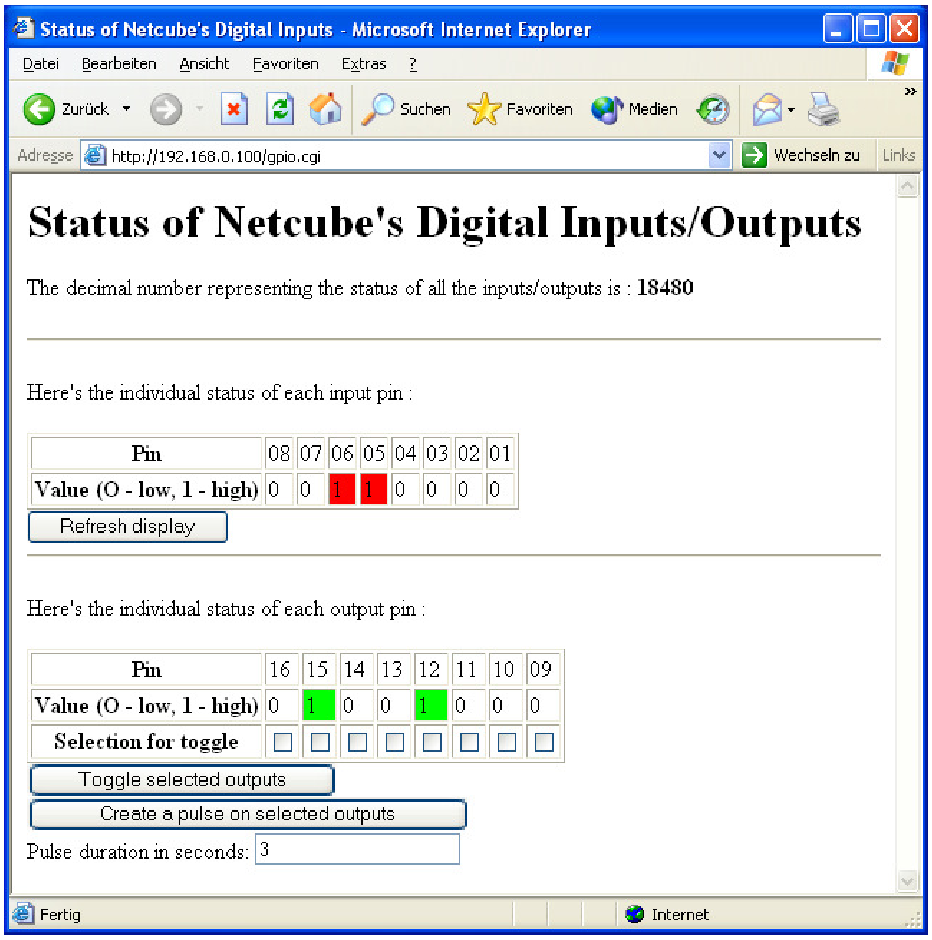
## Description

Numerous NetCube applications involve digital inputs/outputs. This application note tries to summarize the different means which are available to manage the inputs/outputs:

- using interactive CGI scripts
- using non-interactive CGI scripts
- using a simple ASCII-based protocol on a TCP socket
- using custom shell scripts
- using Sigma Program Generator

## Using interactive CGI scripts

If you open your web browser and browse the NetCube web pages, you might find a "GPIO management" web page which looks like this:


Status of Netcube's Digital Inputs - Microsoft Internet Explorer
Datei Bearbeiten Ansicht Favoriten Extras ?
Zurück Suchen Favoriten Medien
Adresse http://192.168.0.100/gpio.cgi
Wechseln zu Links
Fertig
Internet

Status of Netcube's Digital Inputs/Outputs

The decimal number representing the status of all the inputs/outputs is : **18480**

Here's the individual status of each input pin :

| Pin | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 |
|---|---|---|---|---|---|---|---|---|
| Value (O - low, 1 - high) | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

Refresh display

Here's the individual status of each output pin :

| Pin | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 09 |
|---|---|---|---|---|---|---|---|---|
| Value (O - low, 1 - high) | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Selection for toggle | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Toggle selected outputs

Create a pulse on selected outputs

Pulse duration in seconds: 3

You can see which inputs are activated and you can toggle all outputs (or create a pulse on it). Such a CGI is interactive and usually requires a human behind the computer to manage the GPIO. It's useful for tests and/or very occasional manipulations.

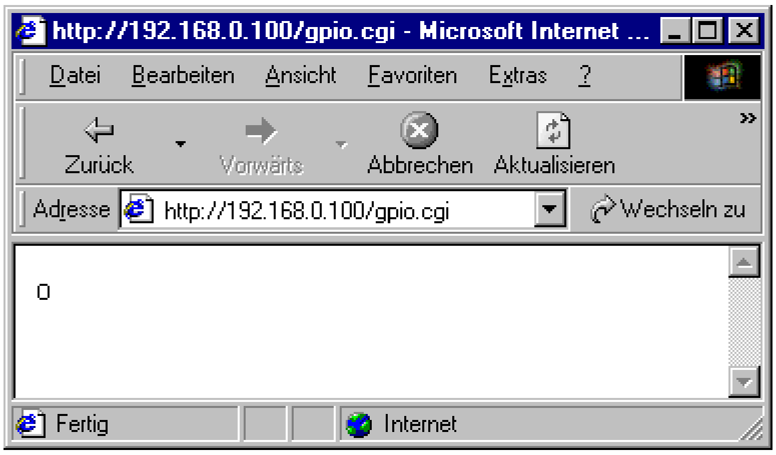
The screenshot above comes from a NetCube Web-IO. A similar screen is available for NetCubes Web-Input but with inputs only. Those CGI scripts are provided on standard NetCubes.

## Using non-interactive CGI scripts

Some customers want to manage the GPIO over HTTP from a remote program. We developed some simple non-interactive CGI scripts for them. A "GET" request on gpio.cgi would return a decimal number describing the state of all inputs: each bit of the number represents the state of an input. With a NetCube Web-Input you'd get a number between 0 and 65536 (2^16) and with NetCube Web-IO you'd get a number between 0 and 255 (2^8).The number can be seen as a sum of values which depend on the state of the input:

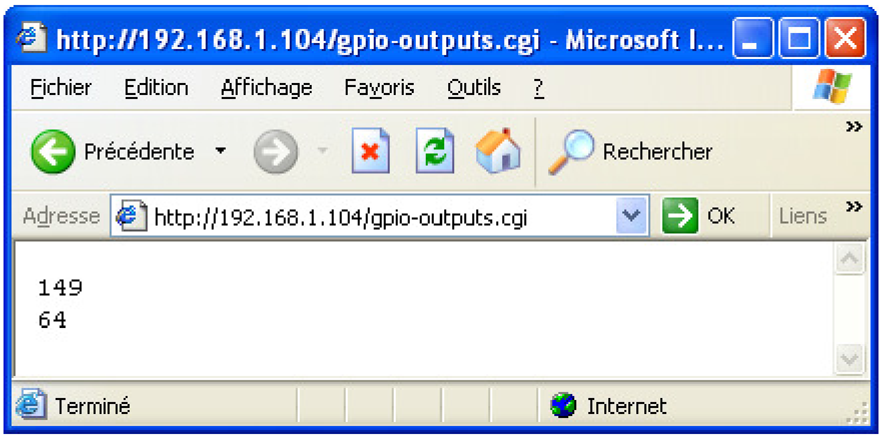
| **Pin** | **16** | **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Value high** | 32768 | 16384 | 8192 | 4096 | 2048 | 1024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| **Value low** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Thus if pin 7, 4 and 3 were on and all other off, we'd read 64 + 8 + 4 = **76**.


http://192.168.0.100/gpio.cgi - Microsoft Internet ...
Datei Bearbeiten Ansicht Favoriten Extras ?
Zurück Vorwärts Abbrechen Aktualisieren
Adresse http://192.168.0.100/gpio.cgi
Wechseln zu
Fertig
Internet

```
0
```

NetCube with digital outputs would also have a “gpio-outputs.cgi” CGI script. A “POST” or “GET” request should provide a “value” parameter between 0 and 255 describing the status of all 8 outputs following the same logic than above. In return it would give back two numbers, one representing the status of all outputs and the other one representing the status of all inputs.


http://192.168.1.104/gpio-outputs.cgi - Microsoft I...
Fichier Edition Affichage Favoris Outils ?
Précédente
Rechercher
Adresse http://192.168.1.104/gpio-outputs.cgi
OK
Liens
Terminé
Internet

```
149
64
```

Those non-interactive CGI scripts are not provided by default. If you need this feature, please get in touch with us, we can customize the NetCube for your needs.

## Using a simple ASCII-based protocol on a TCP socket

For more fine-grained control over the digital inputs/outputs, you can use the service of our “GPIO server”. This server listens on port 3000 of the NetCube and is available on all standard NetCubes Web-IO.

The server uses a simple ASCII-based protocol. It supports several commands:

- read one input (Q:GET-INPUT)
- read a set of inputs (Q:GET-INPUTS)
- change one outputs (Q:SET-OUTPUT)
- change a set of outputs (Q:SET-OUTPUTS)
- be informed when an input (of a given set) changes (Q:SET-SCANMASK)

Example of communication (**`sent`** / `received`):

```
Q:GET-INPUT 1
A:INPUT 1 0
Q:GET-INPUTS 255
A:INPUTS 255 99
Q:SET-OUTPUTS 65280 32768
A:OK
Q:SET-SCANMASK 127 2 50
A:OK
```

```
I:INPUTS 127 40
I:INPUTS 127 32
```

Detailed information about this protocol are available in the manual.

## Using custom shell scripts

Shell scripts can interact with the inputs/outputs via files in the virtual file-system /proc/. Please find below the explanations of the various syntaxes that can be used:

```
      cat /proc/gpio/value
```

This returns a decimal value between 0 and 65535. This is simply the decimal value of the binary representation of all the inputs/outputs. Suppose that all pins are set to 0 and pin 10 is set to 1. We have “0000001000000000” as binary representation and the corresponding decimal value is 512 ($2^{10-1}$).

```
      Cat /proc/gpio/X/value
```

This returns the value for the pin *X+1* (where *X* is between 0 and 15 **and not 1-16**). This value can be “0” or “1”.

```
      echo Y >/proc/gpio/value
```

*Y* is the decimal value corresponding to the desired binary representation of all outputs. Pins configured as inputs are left untouched in all cases.

Suppose that you want to set pin 11 to 1, pin 13 to 1 and all other pins to 0. That means you want the following binary representation :
`00010100........`
The corresponding decimal value is 5120 ($1*2^{11-1}+1*2^{13-1}$). The command is thus :
```
      echo 5120 > /proc/gpio/value
```

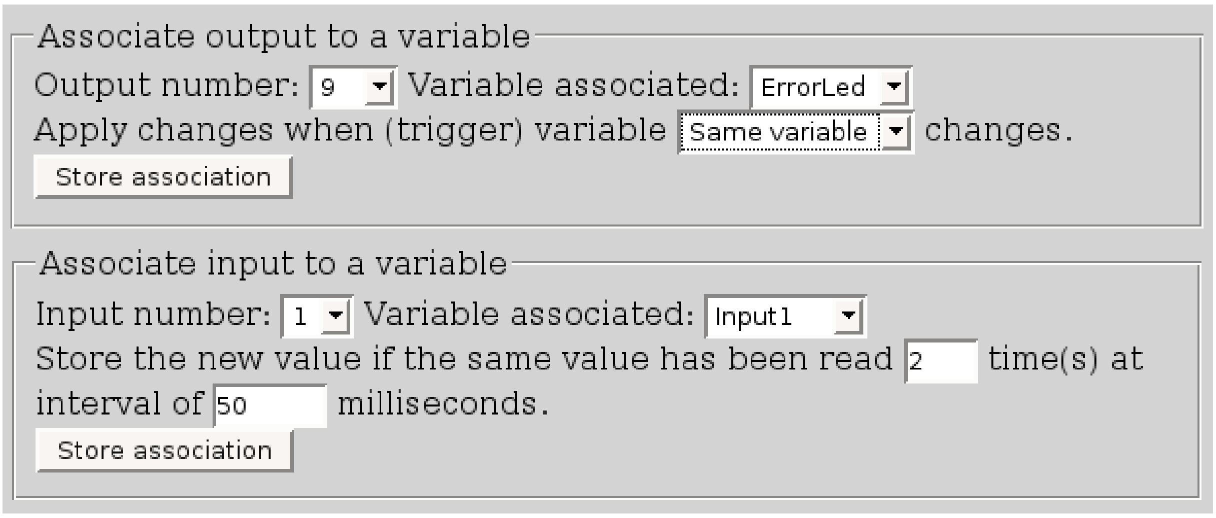
You can change the value of a single output (leaving the others untouched) with :
```
      echo 0 > /proc/gpio/X/value
      echo 1 > /proc/gpio/X/value
```
Those commands defines the value of the pin *X+1* (where *X* is between 8 and 15 **and not 9-16**)

## Using Sigma Program Generator

The Sigma Program Generator offers a “GPIO module” which ties Sigma variables to either digital inputs or digital outputs. For inputs, the corresponding variable is updated as soon as the input changes, and for outputs, the output is updated when the application changes the value of the variable.

Checkout the Sigma Program Generator Tutorial for a concrete example on how to manage GPIO within a Sigma application. You can also browse the integrated documentation on your NetCube.

Screenshot of the corresponding Sigma web page:


Associate output to a variable
Output number: 9 Variable associated: ErrorLed
Apply changes when (trigger) variable Same variable changes.

Associate input to a variable
Input number: 1 Variable associated: Input1
Store the new value if the same value has been read 2 time(s) at interval of 50 milliseconds.