



PC INTERFACING

CP4436

Inspiring The Next
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Preparation

Before tackling the worksheets you will need to understand some basic information:

Microcontroller Basics

These worksheets assume that you have completed a basic course in microcontroller programming like our Introduction to microcontroller programming course.

Board Datasheets

The worksheets make use of two downstream boards:

BL0144 Temperature and humidity sensor

BL0114-2 Combination board

Information on these boards is given in the EBlocks 3 datasheet.



WORKSHEETS

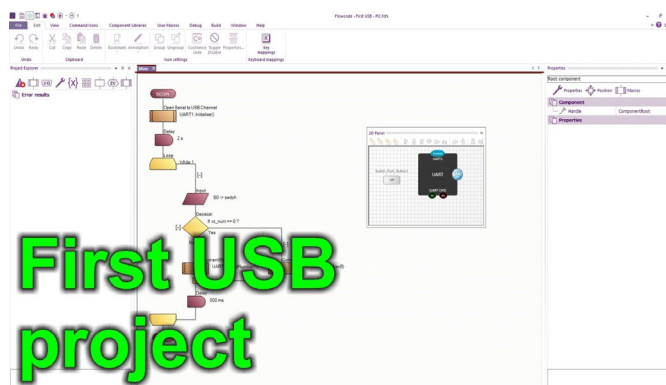


WORKSHEETS

Worksheet 1 – Beginning Hardware Interfacing

Traditional electronic control panels take a lot of putting together. It is far easier to create a virtual control panel on a PC link that to some low cost interface – like an Arduino Uno.

In this worksheet you learn how you can use a PC to control and monitor the state I/O lines on an Embedded device.



CP4436 - PC INTERFACING VIDEO CONTENT

Over To You

- Watch the video “PC Developer first USB project” on the Flowcode YouTube site.
- For this learning package there will be two programs: Embedded and PC Developer.
- Load the file “First USB - PIC” into Flowcode. Set up the hardware appropriately and compile this to the microcontroller.
- Load the file “First USB – PC”. Set up the USART com port to the Embedded USB connection. Select DEBUG...RUN.
- The embedded program looks at the status of a switch on the microcontroller and sends this as a 1 or a 0 to the PC.
- The PC program looks at the USB port for data: in this case a 1 or a 0, and it alters the status of an on-screen LED accordingly.

Challenge:

- Alter the Embedded program so that it sends the value of a potentiometer – between 0 and 255 – to the PC.
- Alter the PC program so that it receives a single number and shows it on a display.

WORKSHEETS

Worksheet 1 – Beginning Hardware Interfacing

Hints:

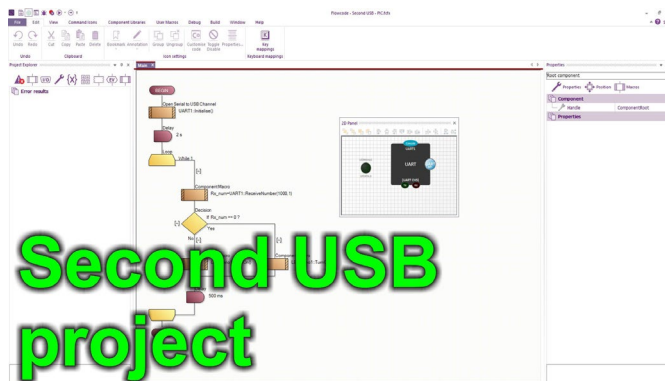
Embedded program:

1. Set up a new variable – POTVOLT - with Type Byte
2. Use the GetVoltage macro to read the potentiometer input as a voltage into POTVOLT
3. Use the UART Sendnumber command to send this to the PC via USB

PC program:

1. Put a Circular Gauge component on the panel. This takes variables of Type Float – not just a simple byte.
2. Create a new variable FloatPot type Float. You will need to assign this to the value of the incoming PotVolt variable with a command like: FloatPot = FLOAT PotVolt.
3. Use the Circular Gauge to display the incoming value.

Part 2



CP4436 - PC INTERFACING VIDEO CONTENT

Over To You

- Watch the video “PC Developer second USB project” on the Flowcode YouTube site.
- For this learning package there will be two programs: Embedded and PC Developer.
- Load the file “Second USB - PIC” into Flowcode. Set up the hardware appropriately and compile this to the microcontroller.
- Open a 2nd Flowcode application and Load the file “Second USB – PC”. Set up the USART com port to the Embedded USB connection. Select DEBUG...RUN.
- The PC program looks at the state of the on-screen switch: in this case a 1 or a 0, and it sends this value to the USB port.
- The embedded program looks at the incoming data on the USB port and alters the value of a LED on the hardware accordingly.

WORKSHEETS

Worksheet 1 – Beginning Hardware Interfacing

Challenge:

- Alter the PC program so that it sends the value of an on-screen slider – between 0 and 255 – to the PC.
- Alter the PC program so that it receives a single number and shows it on a display.

Hints:

Embedded program:

1. Delete the LED.
2. Trap the incoming value from the USB component.
3. Display the value of the slider on the LCD display.

PC program:

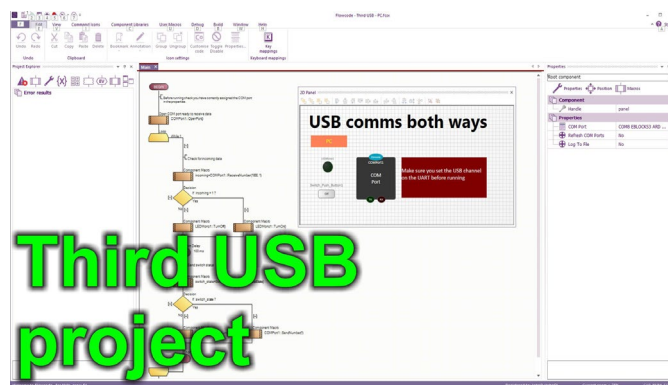
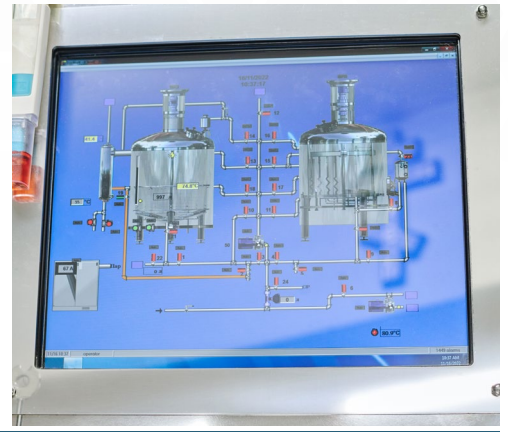
1. Replace the switch for a Slider.
2. Alter the program so that it reads the value of the slider and sends a value between 0 and 255 via the USB component

WORKSHEETS

Worksheet 2 – Bidirectional Hardware Control

In practice most Human Machine Interfaces need bidirectional transfer of information – in this case using the USB lead.

In this worksheet you implement your first proper HMI.



CP4436 - PC INTERFACING VIDEO CONTENT

Over To You

- Watch the video “PC Developer third USB project” on the Flowcode YouTube site.
- For this worksheet there will be two programs: Embedded and PC Developer.
- Load the file “Third USB - PIC” into Flowcode. Set up the hardware appropriately and compile this to the microcontroller.
- Open a 2nd Flowcode Window and Load the file “Third USB – PC”. Set up the USART com port to the Embedded USB connection. Select DEBUG...RUN.
- This is a bidirectional data transfer system: both the PC and the embedded system look for the status of a switch locally and send it via USB. Each system then looks for incoming data and puts it on a LED.

Hints:

For the embedded system:

1. Develop the program so that it reads the value of a potentiometer and transmits it as a number via USB to the PC.
2. Develop the program so that it receives a number in the range 0 – 255 and displays it on the local LCD display.

For the PC system:

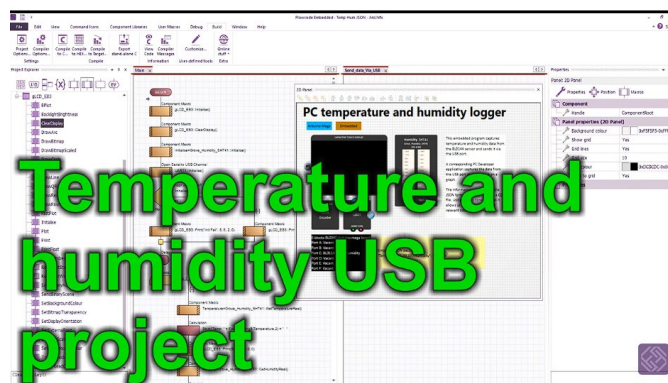
1. Develop the program so that it reads the number and publishes it on a gauge.
2. Develop the program so that it reads the value of a circular knob and transmits it via USB.

WORKSHEETS

Worksheet 3 – JSON Encoding

As you get larger amounts of data going between a PC and an embedded system, tracking each bit of data in a packet gets harder. The JSON encoding scheme makes data management much easier.

In this worksheet you learn how the JSON system works.



CP4436 - PC INTERFACING VIDEO CONTENT

Over To You

- Watch the video “PC Developer program to monitor temperature and humidity on the PC” on the Flowcode YouTube site.
- For this worksheet there will be two programs: Embedded and PC Developer.
- Load the file “Temp Hum JSON - Ard” into Flowcode. Set up the hardware appropriately and compile this to the microcontroller.
- Load the file “Temp Hum JSON – PC”. Set up the USART com port to the Embedded USB connection. Select DEBUG...RUN.
- This program uses JSON encoding to send temperature data to the PC via the USB lead.
- Use the Console to see the incoming data from the Embedded system – this allows you to see the JSON data packet structure.

Challenge:

- Flowcode Embedded: Modify the program so that the status of two switches are also transmitted with in JSON packet.
- Flowcode PC developer: modify the program to include two panel switches that reflect the status of the switches on the hardware.
- Add a text box that shows the value of the Humidity data sent in the JSON packet.

WORKSHEETS

Worksheet 3 – JSON Encoding

Hints:

Embedded:

1. Add two switches to the Embedded panel and two Type Byte variables.
2. Associate the value of the variables with the state of the switches.
3. Add these to the JSON packet.

PC Developer:

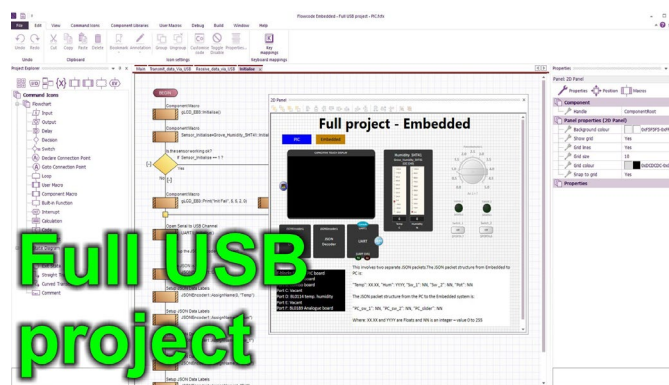
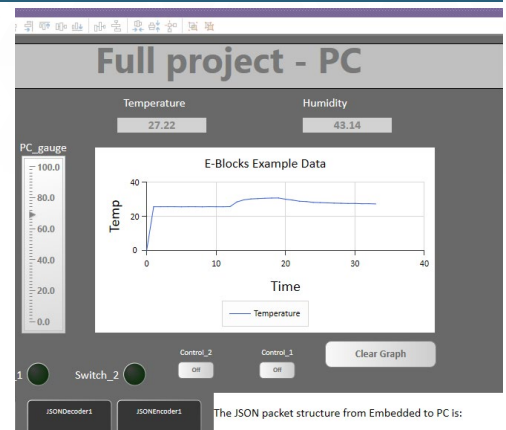
1. Add two LEDs to the PC Developer panel.
2. Extract the value of the switches from the incoming JSON packet.
3. Alter the state of the LEDs accordingly.

WORKSHEETS

Worksheet 4 – Embedded Project

Once you understand JSON then larger bidirectional control and monitoring projects are just larger programs.

In this worksheet you establish quite a significant PC control and monitoring system that you can adapt for your own projects.



CP4436 - PC INTERFACING VIDEO CONTENT

Over To You

- Watch the video “PC Developer full USB project” on the Flowcode YouTube site.
- For this worksheet there will be two programs: Embedded and PC Developer.
- Load the file “Full USB project - Ard” into Flowcode. Set up the hardware appropriately and compile this to the microcontroller.
- Load the file “Full USB project – PC”. Set up the USART com port to the Embedded USB connection. Select DEBUG...RUN. (note that the screen will freeze until you send data to it using the PC Developer programme).
- This program uses JSON encoding to send data to and from the Embedded system and the PC to form a quite comprehensive Human Machine Interface.
- In PC Developer use the Console to see the incoming data from the Embedded system whilst altering the status of the Embedded system IO. The console allows you to see the JSON data packet structure.

Challenge:

1. Flowcode Embedded: add a DC motor to the Embedded system. Alter the program so that the speed is controlled from the PC Developer program. Alter the program so that one of the PC Developer switches controls the direction of the motor.
2. Flowcode PC Developer: Set the cursor to a new line and print the value of HUMINT

WORKSHEETS

Worksheet 4 – Embedded Project

Hints:

1. Add a motors component to the Embedded panel. Use the incoming data and the DC motor hardware macros to trap incoming data and make appropriate adjustments.

Notes for Future Work:

An issue with this system is the timing between the Embedded System and the PC Developer system. In practice this is better controlled with an interrupt to monitor incoming communications on the USB port and a circular buffer to store data.

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