Arduino Programming Guide on pcDuino

HISTORY

Version	Date	Description	Author
0.1	3/07/2013	Initial draft	Lifeng Zhao

INDEX

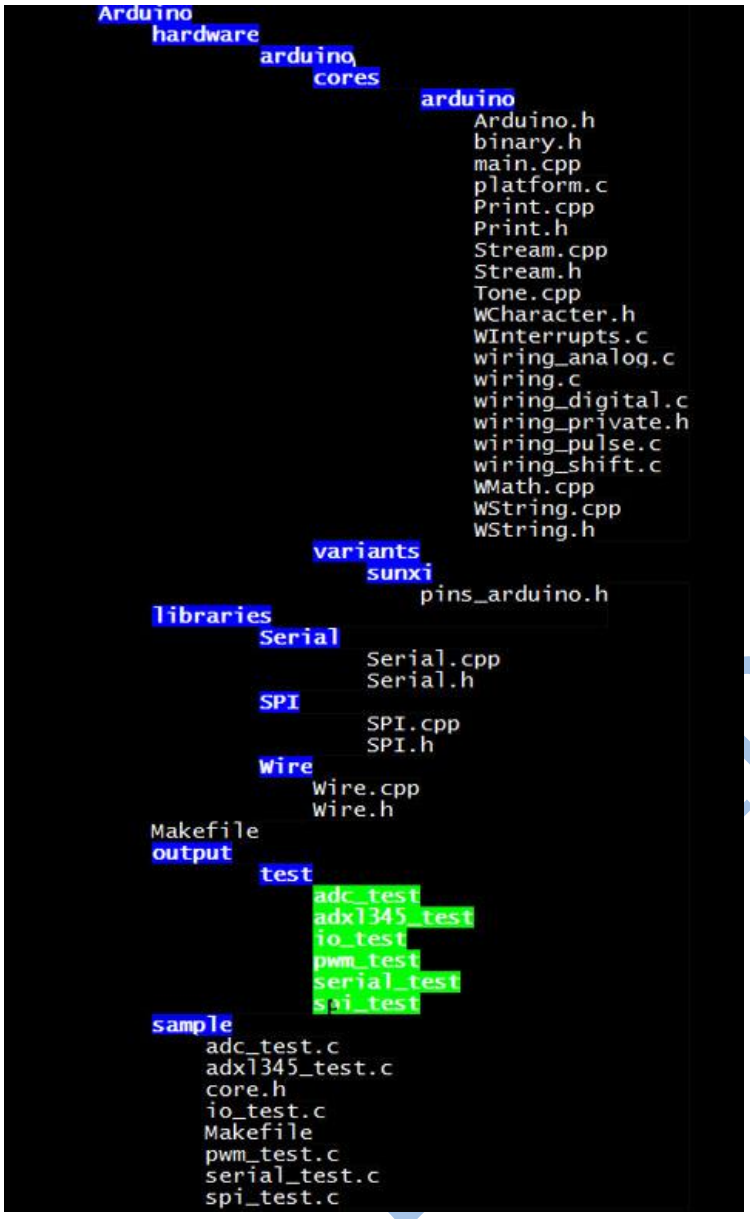
1. Overview

This document gives the brief introduction on how to write Arduino style program on your pcDuino. To start, please have the follows ready:

1. Documentation
   a) pcDuino user manual
   b) This guide
2. Software environment
   a) The Ubuntu patch (from https://s3.amazonaws.com/pcduino/Images/Ubuntu+Updates/uImage-03-11-2011.rar).
   If your Ubuntu image is made before March 11th., 2013, please apply this patch before trying the Arduino samples below.
   b) The Arduino library (from https://github.com/pcduino/arduino).
3. Hardware
   a) pcDuino board
   b) USB-to-serial cable (i.e., PL2303HX)

The current version of Arduino library is version 0.1. Please note that you couldn't apply this to the Ubuntu image released before March 11th., 2013. Many of the library APIs are dependent on the new driver implementation in the OS kernel version released after March 11th., 2013.

Source tree of Arduino library:



Toolchain of the Arduino library

The source code could be compiled with GCC tool chain. The GCC is pre-installed on the board. You could enter gcc in Ubuntu terminal under any directory.

Cautious: you may need a bridge board to work with 5V Arduino Shield

All IO on the pcDuino board are 3.3V IO.

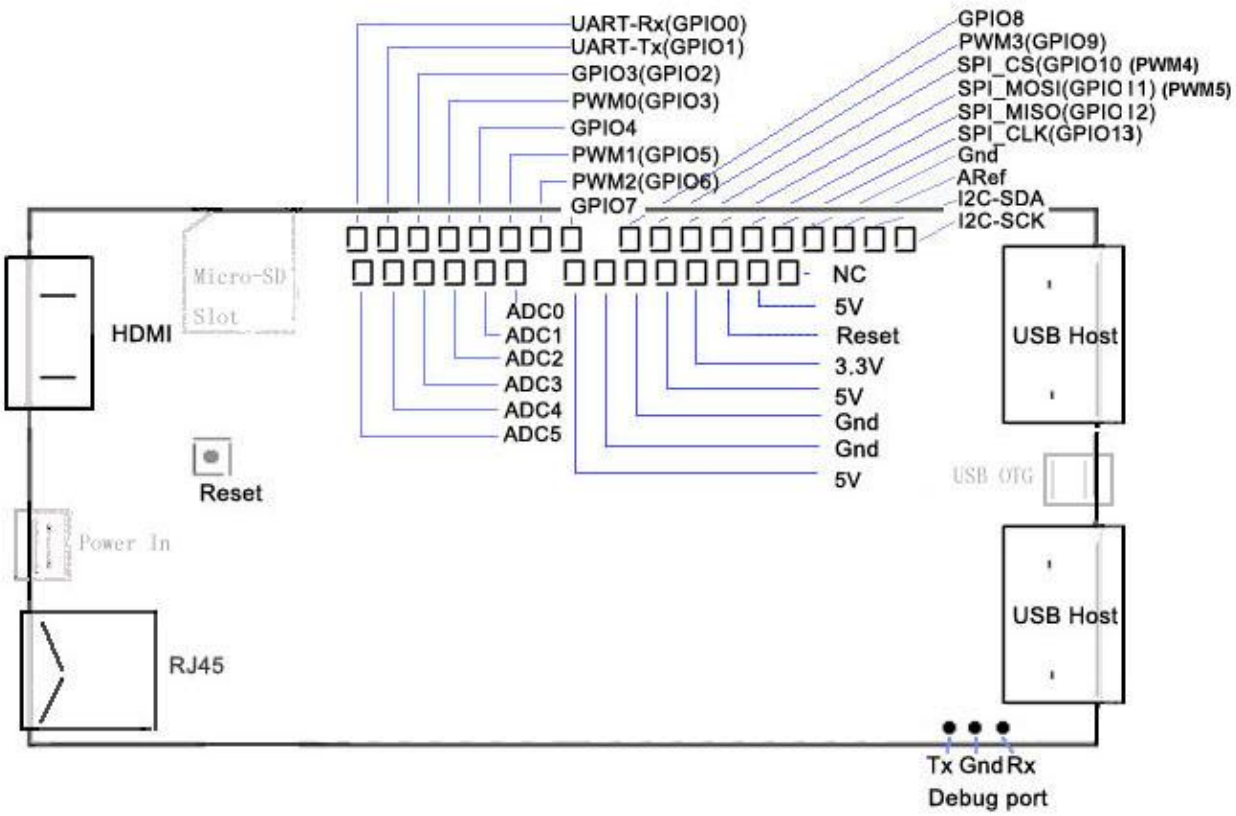
If the Arduino shield needs 5V input or 5V output, you need a bridge board for pcDuino. Otherwise, you may damage your pcDuino board if you directly connect your shield with the pcDuino.

2. Arduino stype I/O interface

Here is the list of I/O interfaces on pcDuino board.

- 14 GPIOs
- One UART
- Six PWMs
- Six ADCs
- One SPI
- One I2C

User could connect the Arduino shield with pcDuino via any of the I/O interfaces above. It allows users to leverage the existing Arduino code and apply to pcDuino easily. There are some limitations and differences compared with original Arduino board. Please refer chapter 3 for details.



3. Arduino library and samples

3.1 UART

Reference:

Please refer to the Serial class from Arduino (http://arduino.cc/en/Reference/Serial).

Functions

- if (Serial)
- available()
- begin()
- end()
- find()
- findUntil()
- flush()
- parseFloat()
- parseInt()
- peek()
- print()
- println()
- read()
- readBytes()
- readBytesUntil()
- setTimeout()
- write()
- serialEvent()

UART Rx and Tx pins are shared with GPIO 0 and 1. Thus, if you are using UART, please don't call pinMode to change function mode of GPIO 0 and 1.

Currently, the supported baud rates are: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 Hz.

Sample

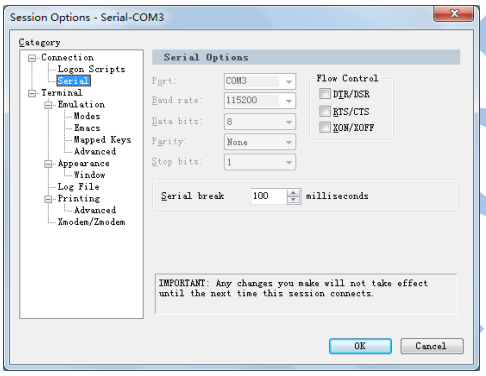
Accept the typing from the terminal, then print out the input in the second line. Both read and write operations are via UART interfaces.

Setup

Plugin USB-to-serial cable to PC USB port and install usb_to_serial driver to PC

Check the windows computer device manager for com port device.

Run a terminal tool like “sercureCRT”, and configure the serial port parameters to 115200 8N1.



Then you can type on the terminal and see the output prints.

If you use Linux PC, you could use minicom tool for this sample.

Sample code

```
void setup() {
    //Initialize serial with baudrate setting, the default config is SERIAL_8N1
    int rate = 115200;
    Serial.begin(rate);

    //you will see the string on the terminal
```

```
        Serial.println("Serial begin: ");
}

void loop() {
        //if you type the character in the terminal, available() will return the size you typed
        if (Serial.available() > 0) {
                // read the incoming byte:
                char thisByte = Serial.read();

                //print it on the terminal with DEC format
                Serial.print("I received: ");
                Serial.println(thisByte, DEC);
    }
    delay(200);
}
```

3.2 ADC

Arduino functions

analogReference()

pcDuino has the internal reference voltage. For ADC0 and ADC1, the reference is 2V, for ADC2~5, the refernece is 3.3V. Thus, this function doesn't change the reference voltage which is different from original Arduino board.

analogRead()

ADC0 and ADC1 are 6-bit ADC, the return value is from 0 ~ 63, ranging from 0V to 2V.
ADC2~ADC5 are 12-bit ADC, the return value is from 0 ~ 4095, means from 0V to 3.3V.

Notes:

1. If you want to measure the high voltage, you can purchase the bridge board for pcDuino, it can measure max 5V input.

2. For ADC0 and ADC1, though this function will return in 4us, the actual conversion rate is 250Hz. So if the input voltage changed, it can be detected in 4ms. For ADC2~ADC5, this function will return in 35us, the return value is the actual value measured.

Sample

Measure thedry battery's voltage

Setup

Connect the battery's N to any GND and P to the ADC1

Sample Code

Read the value of ADC

```
Int adc_id = 0;
void setup() {
      //argv[1] store the adc id that will be measured.
      //if no args, default adc_id is 0
       if ( argc == 2 )
            adc_id = atoi(argv[1]);
}
```

```
void loop() {
      // get adc value
      int value = analogRead(adc_id);

      //delay some time in loop
      delayMicroseconds(100000);
}
```

3.4 PWM

Reference

analogWrite()

- with value 0 to set the PWM IO to low level.

Notes:

1. PWM1 and PWM2 are hardware PWMs. They are set to 520Hz with 256 duty cycle level by default. PWM1/3/4/5 are 5Hz with 10 duty cycle level by default. Thus, the actual duty level is *value*10/256*. PWM1/3/4/5 are simulated by GPIO in software, so they couldn't set high frequency. If you need simulate high frequency and accurate PWM with software GPIO, the CPU will be in very high use.
2. The six PWM pins are shared with GPIO, and PWM4/PWM5 pins are also shared with SPI IO. So if you are using PWM, don't call pinMode() or SPI function to specific IO.

Functions not implemented

tone()

noTone()

tone function can generate a square wave with the setting frequency and duration.

You can't use tone function to play the ringtones as Arduino does, because pcDuino's tone function can work under just several frequency setting. We will improve this in future release.

An extend function will be provided for those who needs higher or lower frequency PWM. So far, we couldn't support 256 duty cycle level in every frequency. Assume the max duty cycle in this frequency is *max_level*, the actual level will be *level * max_level/256*. This function is also useful for tone() function.

PWM1/3/4/5 will be improved in future release. The ultimate goal is to provide 500Hz support with 256 duty cycle.

Sample

Use PWM to control buzzer to make sound in different frequency

Setup

A buzzer connect to PWM1

Sample code

```
int pwm_id = 1;
int duty_level = 128;
```

```
void setup() {
        //set the default freq (#define default_freq 0)
       //PWM0/3/4/5, default_freq is 5Hz, and PWM1/2 is 520Hz
        if ( argc > 1 )
           pwm_id = atoi(argv[1]);
       if ( argc > 2 ) //duty level can be 0 ~ 256
           duty_level = argv[2];

       //start the PWM
      analogWrite(pwm_id, duty_level);
}

void loop() {
       //delay in loop
      delay(10);
}
```

3.4 GPIO

Reference functions

pinMode()
digitalRead()
digitalWrite()
pulseIn()

Sample

Turn on or off LED by pressing and releasing the button connected to the GPIO

Setup

Connect the shield to the GPIO1 and connect the LED to GPIO5

Sample code

```
int led_pin = 5;
int btn_pin = 1;
void setup() {
      if ( argc == 3 ) {
            btn_pin = atoi(argv[1]);
            led_pin = atoi(argv[2]);
      }
      //set the gpio to input or output mode
      pinMode(led_pin, OUTPUT);
      pinMode(btn_pin, INPUT);
}

void loop() {
       //press btn_pin to turn on LED
      int value = digitalRead(btn_pin);
      if ( value == HIGH )    { // button pressed
            digitalWrite(led_pin, HIGH); // turn on LED
      } else    { // button released
                digitalWrite(led_pin, LOW); // turn off LED
      }
```

```
    delay(100);
}
```

3.5 I2C

Reference function

Please refer to the Wire class (http://arduino.cc/en/Reference/Wire)

Functions

- begin()
- requestFrom()
- beginTransmission()
- endTransmission()
- write()
- available()
- read()
- onReceive()
- onRequest()

pcDuino I2C is set 200KHz, 7-bit version, master only by default

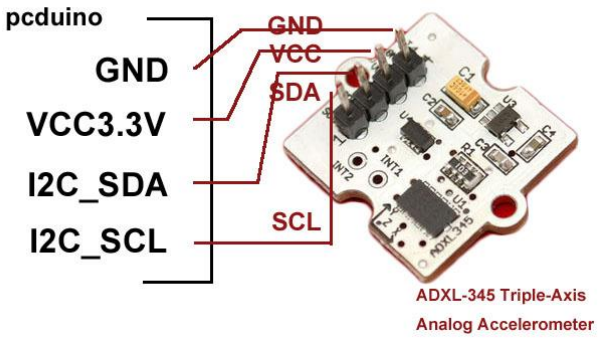
Future improvements:
Function will be provided to users to allow them to configure the I2C frequency. And we will also support 10-bit mode.

Sample

Read the X, Y and Z coordinates for triple axis via I2C interface

Setup

Connect the I2C port of Triple-Axis with pcDuino



Sample code

Please refer to *adxl345_test.c*

3.6 SPI

Reference functions

Please refer to the SPI class. (http://arduino.cc/en/Reference/SPI)

Functions

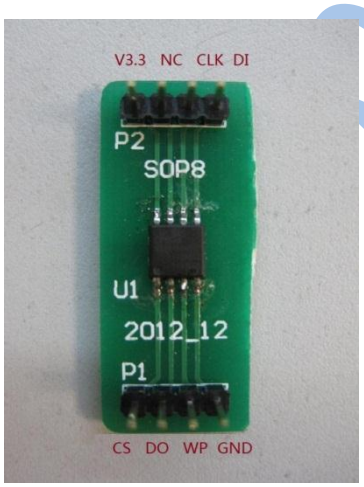
- begin()
- end()
- setBitOrder()
- setClockDivider()
- setDataMode()
- transfer()

pcDuino SPI only works in master mode. The max speed is 12MHz. Clock divider can be 2/4/8/16/32/64/128. Note that calling the setClockDivider() function just saves the setting of clock divider but without the real clock change. It works when the transfer function called.

Sample

To read an SPI flash ID of M25P16

Setup



GND ---------- GND
V3.3 ---------- 3.3V
DO ---------- SPI_MISO
DI ---------- SPI_MOSI
CS ---------- SPI_CS
CLK --------- SPI_CLK

Sample code

```
int ReadSpiflashID(void) {
      char CMD_RDID = 0x9f;
      char id[3];
      int flashid = 0;

      memset(id, 0x0, sizeof(id));
      id[0] = SPI.transfer(CMD_RDID, SPI_CONTINUE);
      id[1] = SPI.transfer(0x00, SPI_CONTINUE);
      id[2] = SPI.transfer(0x00, SPI_LAST);

       //MSB first
        flashid = id[0] << 8;
        flashid |= id[1];
        flashid = flashid << 8;
        flashid |= id[2];

        return flashid;
}

void setup() {
    // initialize SPI:
      SPI.begin();
}

void loop() {
      //MSB first
      printf("spi flash id = 0x%x\n", ReadSpiflashID());
      delay(2000);
}
```