



DesignNews

Raspberry Pi 4B Application Development Using the C Programming Language

DAY 5: Coding a Raspberry Pi 4B Serial IoT Application

Sponsored by



Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Group Chat’ by maximizing the chat widget in your dock.
- Submit questions for the lecturer using the Q&A widget. They will follow-up after the lecture portion concludes.

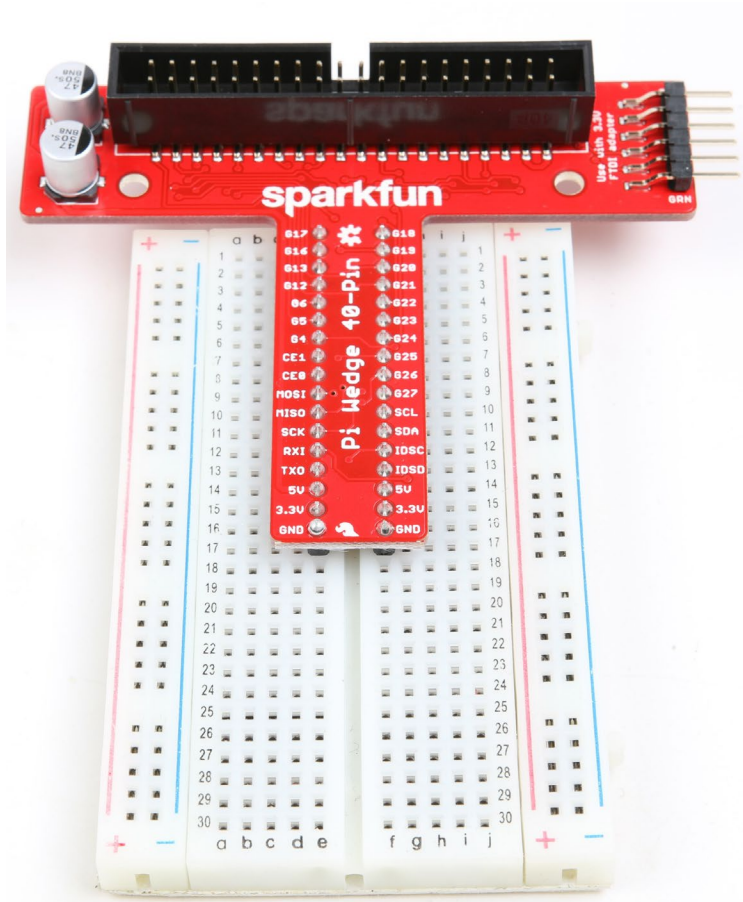


Fred Eady

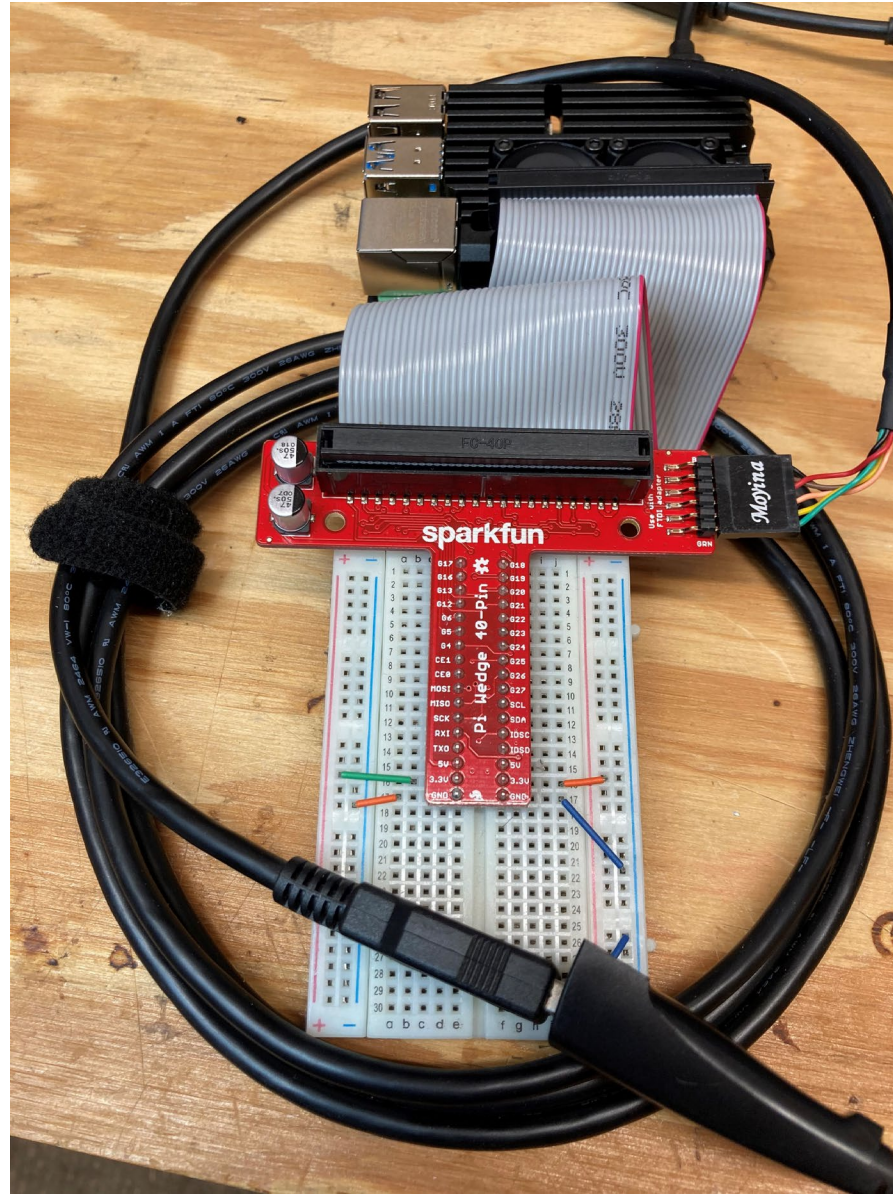
Visit 'Lecturer Profile' in your console for more details.

AGENDA

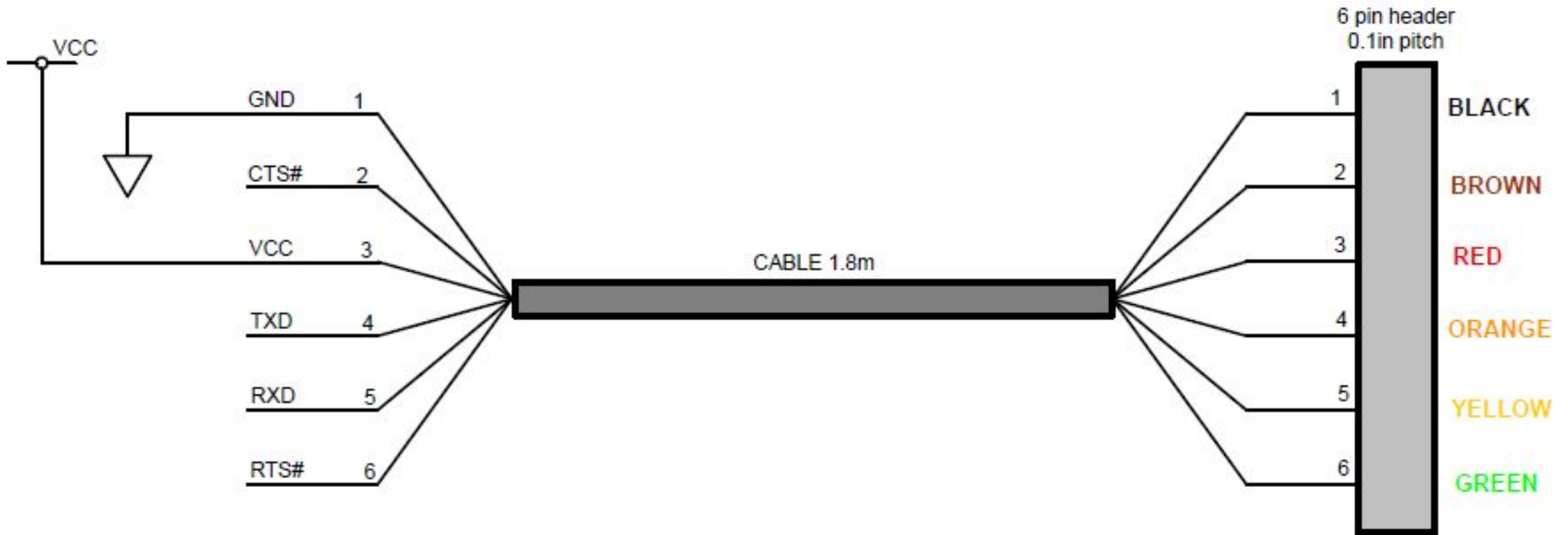
Serial Interfacing



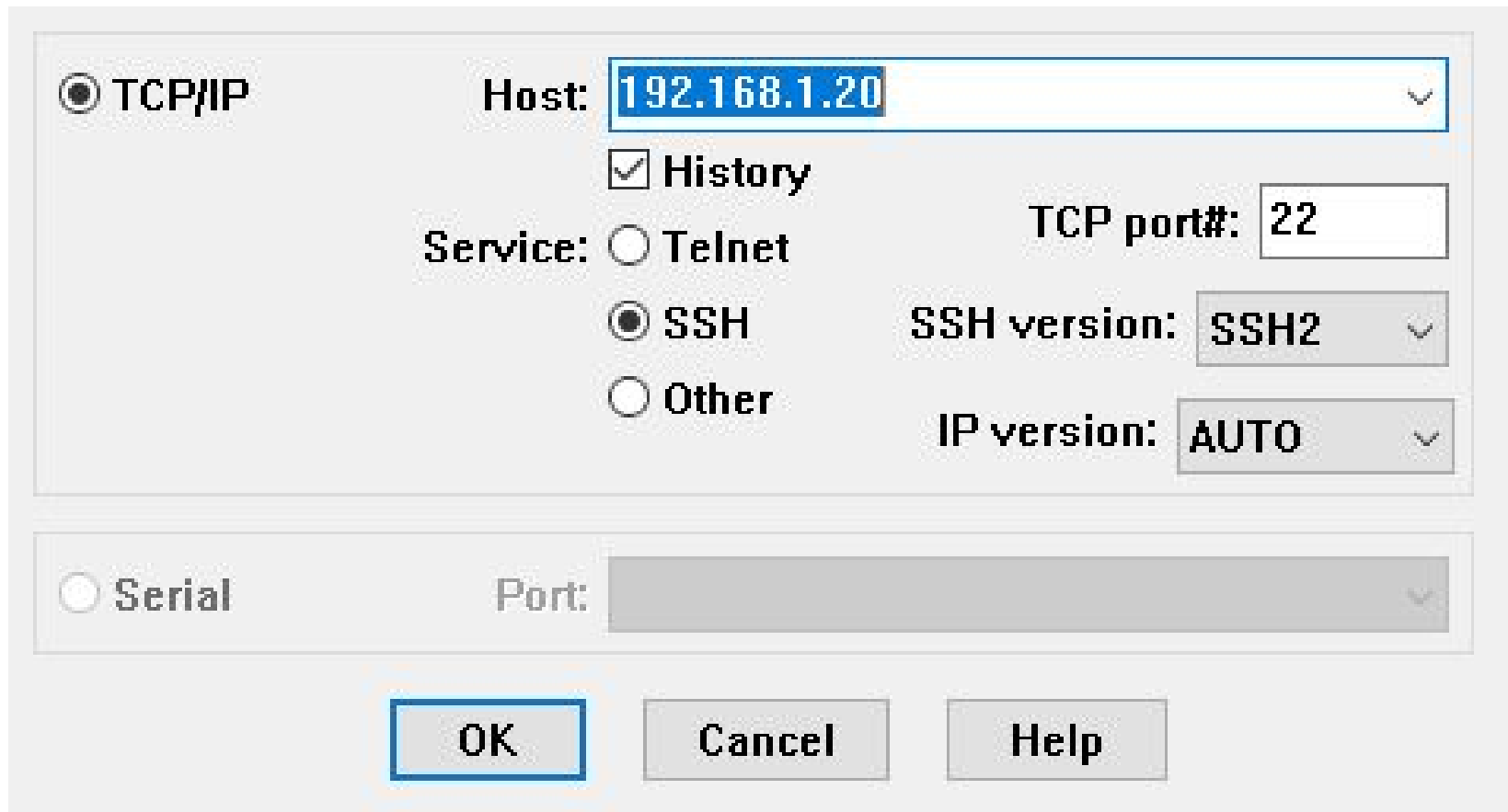
Serial Interfacing – Hardware



Serial Interfacing – FTDI Cable



Serial Interfacing – SSH via Tera Term



The screenshot shows the Tera Term connection settings dialog box. The 'TCP/IP' radio button is selected. The 'Host' field contains '192.168.1.20'. The 'History' checkbox is checked. The 'Service' section has 'SSH' selected. The 'TCP port#' is '22', 'SSH version' is 'SSH2', and 'IP version' is 'AUTO'. The 'Serial' radio button is unselected and its 'Port' field is empty. At the bottom, the 'OK' button is highlighted with a blue border.

TCP/IP Host: 192.168.1.20

History

Service: Telnet TCP port#: 22

SSH SSH version: SSH2

Other IP version: AUTO

Serial Port:

OK Cancel Help

Serial Interfacing – SSH via Tera Term

Logging in to 192.168.1.20

Authentication required.

User name:

pi

Passphrase:

●●●●●●●●

 Remember password in memory Forward agent

Authentication methods

 Use plain password to log in Use RSA/DSA/ECDSA/ED25519 key to log in

Private key file:

 Use rhosts to log in (SSH1)

Local user name:

Host private key file:

 Use keyboard-interactive to log in Use Pageant to log in

OK

Disconnect

```
Linux cec 5.4.79-071+ #1373 SMP Mon Nov 23 13:27:40 GMT 2020 armv7l
```

```
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/copyright.
```

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.
```

```
Last login: Fri Jan 8 14:01:17 2021 from 192.168.1.240
```

```
pi@cec:~$
```


Serial Interfacing – Echo Example

Tera Term: New connection ✕

TCP/IP

Host: 192.168.1.20

History

Service: Telnet

TCP port#: 22

SSH

SSH version: SSH2

Other

IP version: AUTO

Serial

Port: COM33: USB Serial Port (COM33)

OK Cancel Help

Serial Interfacing – Echo Example

Tera Term: Serial port setup and connection

Port: COM33

Speed: 9600

Data: 8 bit

Parity: none

Stop bits: 1 bit

Flow control: none

Transmit delay
0 msec/char 0 msec/line

Device Friendly Name: USB Serial Port (COM33)
Device Instance ID: FTDIBUS\VID_0403+PID_6001+AI055PPY;
Device Manufacturer: FTDI
Provider Name: FTDI
Driver Date: 8-16-2017
Driver Version: 2.12.28.0

New setting
Cancel
Help

Serial Interfacing – Echo Example

eclipse-workspace - piCproject/src/piCproject.c - Eclipse IDE

File Edit Source Refactor Navigate Search Project Run Window Help

Debug piCproject Debug on: --

Remote System

piCproject.c

```

9 #include <stdio.h>
10 #include <stdlib.h>
11 #include <stdarg.h>
12 #include "pigpio.h"
13
14 //CCS Macros
15 #define bitset(var, bitno) ((var) |= 1 << (bitno))
16 #define bitclr(var, bitno) ((var) &= ~(1 << (bitno)))
17 #define make8(var, offset) (((unsigned short)var >> (offset * 8)) & 0x00FF)
18 #define make16(varhigh, varlow) (((unsigned short)varhigh & 0xFF) * 0x100) + ((unsigned short)varlow & 0x00FF)
19 #define make32(var1, var2, var3, var4) \
20 ((unsigned short)var1 << 24) + ((unsigned short)var2 << 16) + \
21 ((unsigned short)var3 << 8) + ((unsigned short)var4)
22 #define make32i(var1, var2) ((unsigned short)var1 << 16) + ((unsigned short)var2)
23
24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27
28 int main(void)
29 {
30     if(gpioInitialise() < 0) //init pigpio
31     {
32         return 1;
33     }
34     serHandle = serOpen("/dev/serial0", 9600, 0); //open serial0
35
36     do{
37         if(serDataAvailable(serHandle))
38         {
39             scratch8 = serReadByte(serHandle);
40             serWriteByte(serHandle, scratch8);
41         }
42     }while(1);
43 }
44 }
45

```

Console

```

<terminated> piCproject Debug [C/C++ Remote Application] Remote Shell (Terminated Jan 10, 2021, 6:27:33 PM)
gdbserver1 :2345 /home/pi/CECprojects/piCproject;exit
pi@cec:~$ gdbserver1 :2345 /home/pi/CECprojects/piCproject;exit
Process /home/pi/CECprojects/piCproject created; pid = 911
Listening on port 2345
Remote debugging from host 192.168.1.240
logout

```

Writable Smart Insert 30 : 1 : 1013

Serial Interfacing – Echo Example

```
VT COM33 - Tera Term VT
File Edit Setup Control Window Help
aaaaaaaaabbbbbbbbbbbbbbbbbrrrrrrrfff hhhhhhh
```

```
24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27
28 int main(void)
29 {
30     if(gpioInitialise() < 0) //init pigpio
31     {
32         return 1;
33     }
34
35     serHandle = serOpen("/dev/serial0",9600,0); //open serial0
36
37     do{
38         if(serDataAvailable(serHandle))
39         {
40             scratch8 = serReadByte(serHandle);
41             serWriteByte(serHandle,scratch8);
42         }
43     }while(1);
44 }
```

Serial Interfacing – serWrite Example

eclipse-workspace - piCproject/src/piCproject.c - Eclipse IDE

File Edit Source Refactor Navigate Search Project Run Window Help

Debug piCproject Debug on: --

Debu Proj Remote Syste

piCproject Debug [C/C++ Remote Application]

```

10 #include <stdlib.h>
11 #include <stdarg.h>
12 #include "pigpio.h"
13
14 //CCS Macros
15 #define bitset(var, bitno) ((var) |= 1 << (bitno))
16 #define bitClr(var, bitno) ((var) &= ~(1 << (bitno)))
17 #define make8(var,offset) ((unsigned short)var >> (offset * 8)) & 0x00FF
18 #define make16(varhigh,varlow) (((unsigned short)varhigh & 0xFF)* 0x100) + ((unsigned short)varlow & 0x00FF)
19 #define make32(var1,var2,var3,var4) \
20 ((unsigned short)var1<<24)+((unsigned short)var2<<16)+ \
21 ((unsigned short)var3<<8)+((unsigned short)var4)
22 #define make32i(var1,var2) ((unsigned short)var1<<16)+((unsigned short)var2)
23
24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27 uint8_t rxBuf[64];
28 uint8_t txBuf[64];
29
30 int main(void)
31 {
32     if(gpioInitialise() < 0) //init pigpio
33     {
34         return 1;
35     }
36
37     serHandle = serOpen("/dev/serial0",9600,0); //open serial0
38     scratch16 = 0;
39
40     do{
41         sprintf(txBuf,"Message from a Pi running pigpio! %u \r\n",scratch16++);
42         serWrite(serHandle,txBuf,strlen(txBuf));
43         gpioSleep(PI_TIME_RELATIVE,0,10000); //delay
44     }while(1);
45
46

```

Expression Type Value

Expression	Type	Value
spiTxPkt	uint8_t [2]	0x411010 <spiTx
spiTxPkt[0]	uint8_t	85 'U'
spiTxPkt[1]	uint8_t	170 'a'
+ Add new expressio		

Console Registers Problems Executables Debugger Console Memory

```

piCproject Debug [C/C++ Remote Application]
Last login: Mon Jan 11 13:28:00 2021

gdbserver1 :2345 /home/pi/CECprojects/piCproject;exit

pi@cec:~$ gdbserver1 :2345 /home/pi/CECprojects/piCproject;exit
Process /home/pi/CECprojects/piCproject created; pid = 683
Listening on port 2345
Remote debugging from host 192.168.1.240

```

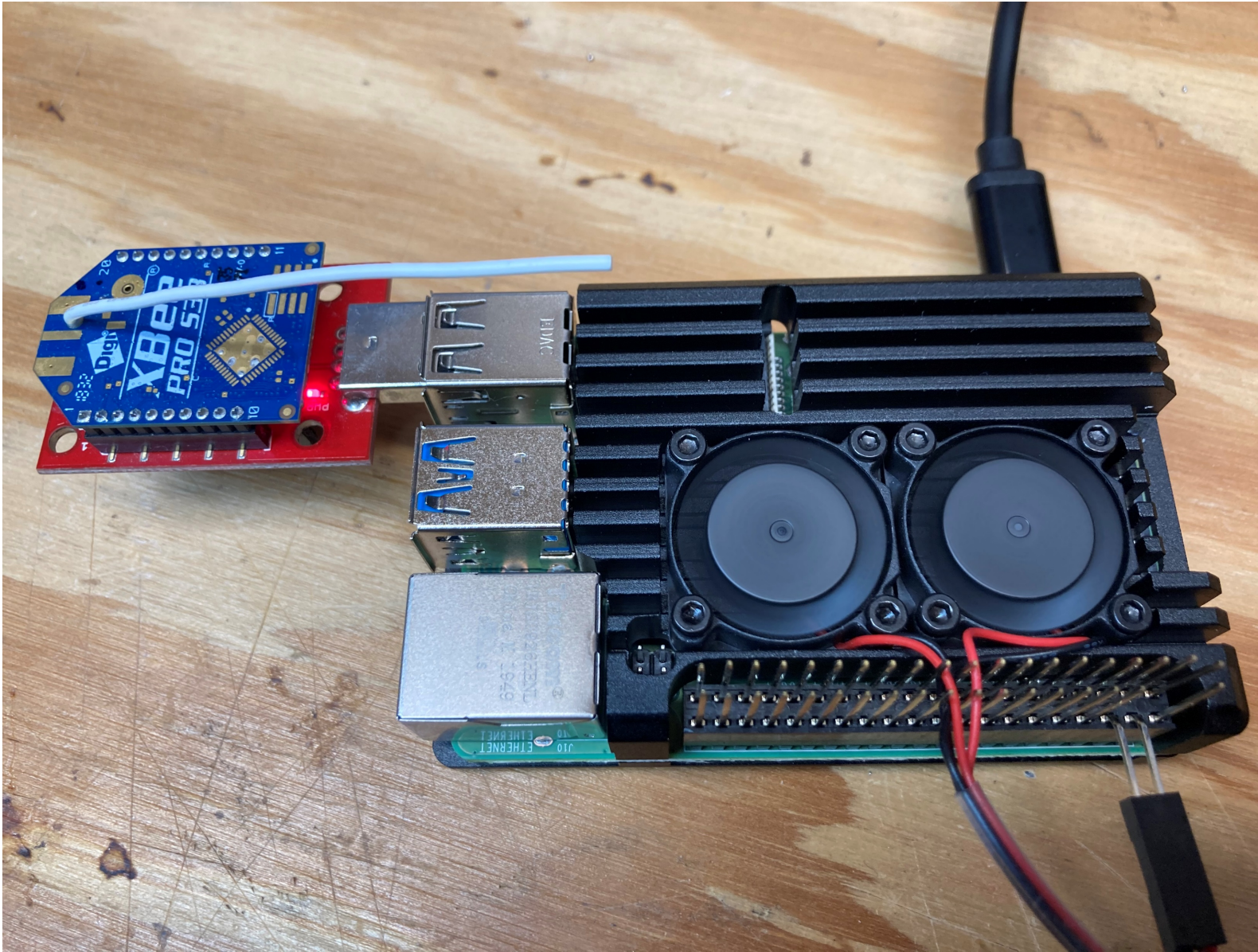
Writable Smart Insert 46 : 1 : 1384

Serial Interfacing – serWrite Example

```
VT COM33 - Tera Term VT
File Edit Setup Control Window Help
Message from a Pi running pigpio! 0
Message from a Pi running pigpio! 1
Message from a Pi running pigpio! 2
Message from a Pi running pigpio! 3
Message from a Pi running pigpio! 4
Message from a Pi running pigpio! 5
Message from a Pi running pigpio! 6
Message from a Pi running pigpio! 7
Message from a Pi running pigpio! 8
Message from a Pi running pigpio! 9
Message from a Pi running pigpio! 10
```

```
24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27 uint8_t rxBuf[64];
28 uint8_t txBuf[64];
29
30 int main(void)
31 {
32     if(gpioInitialise() < 0)                //init pigpio
33     {
34         return 1;
35     }
36
37     serHandle = serOpen("/dev/serial0",9600,0);    //open serial0
38     scratch16 = 0;
39
40     do{
41         sprintf(txBuf,"Message from a Pi running pigpio! %u \r\n",scratch16++);
42         serWrite(serHandle,txBuf,strlen(txBuf));
43         gpioSleep(PI_TIME_RELATIVE,0,10000);    //delay
44     }while(1);
45 }
```

Serial Interfacing – XBee Example



Serial Interfacing – XBee Example

eclipse-workspace - piCproject/src/piCproject.c - Eclipse IDE

File Edit Source Refactor Navigate Search Project Run Window Help

piCproject Debug on: --

Debu Proj Remote Syste

piCproject Debug [C/C++ Remote Application]

```

24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27 uint8_t rxBuf[64];
28 float temperatureF, humidity, pressure;
29
30 int main(void)
31 {
32     if(gpioInitialise() < 0)           //init pigpio
33     {
34         return 1;
35     }
36
37     serHandle = serOpen("/dev/ttyUSB0",9600,0); //open USB0
38
39     do{
40         scratch16 = serDataAvailable(serHandle); //wait for incoming packet data
41         if(scratch16 >= 52)
42         {
43             serRead(serHandle, rxBuf, 52); //read complete packet
44         }
45         if(rxBuf[0] == 0xFA && rxBuf[1] == 0x41)
46         {
47             temperatureF = make16(rxBuf[26], rxBuf[27]);
48             temperatureF /= 10;
49             humidity = make16(rxBuf[30], rxBuf[31]);
50             humidity /= 10;
51             pressure = make16(rxBuf[34], rxBuf[35]);
52             pressure /= 100;
53             printf("TempF = %3.2f\r\n", temperatureF);
54             printf("Humidity = %3.2f%%\r\n", humidity);
55             printf("Barometric Pressure = %3.2fHg\r\n", pressure);
56         }
57         gpioSleep(PI_TIME_RELATIVE, 1, 0); //delay 1 second
58     }while(1);
59 }
60

```

Expression	Type	Value
0+ rxBuf[21]	uint8_t	100
0+ rxBuf[22]	uint8_t	0 '\0'
0+ rxBuf[23]	uint8_t	65 'A'
0+ rxBuf[24]	uint8_t	10 '\n'
0+ rxBuf[25]	uint8_t	112 'p'
0+ rxBuf[26]	uint8_t	1 '\001'
0+ rxBuf[27]	uint8_t	222 'B'
0+ rxBuf[28]	uint8_t	10 '\n'
0+ rxBuf[29]	uint8_t	128 '\200'
0+ rxBuf[30]	uint8_t	2 '\002'
0+ rxBuf[31]	uint8_t	117 'u'
0+ rxBuf[32]	uint8_t	10 '\n'
0+ rxBuf[33]	uint8_t	181 '\u'
0+ rxBuf[34]	uint8_t	11 '\v'
0+ rxBuf[35]	uint8_t	157 '\235'
0+ rxBuf[36]	uint8_t	10 '\n'
0+ rxBuf[37]	uint8_t	192 '\A'

Console

```

piCproject Debug [C/C++ Remote Application]
Barometric Pressure = 29.73Hg
TempF = 47.80F
Humidity = 62.90%
Barometric Pressure = 29.73Hg

```

Writable Smart Insert 4:29:162

Serial Interfacing – XBee Example

```

*piCproject.c  clock_nanosleep() at 0xb6e5bedc
24 uint16_t serHandle;
25 uint16_t scratch16;
26 uint8_t scratch8;
27 uint8_t rxBuf[64];
28 float temperatureF, humidity, pressure;
29
30 int main(void)
31 {
32     if(gpioInitialise() < 0)                //init pigpio
33     {
34         return 1;
35     }
36
37     serHandle = serOpen("/dev/ttyUSB0",9600,0); //open USB0
38
39     do{
40         scratch16 = serDataAvailable(serHandle); //wait for incoming packet data
41         if(scratch16 >= 52)
42         {
43             serRead(serHandle, rxBuf, 52); //read complete packet
44         }
45         if(rxBuf[0] == 0xFA && rxBuf[1] == 0x41)
46         {
47             temperatureF = make16(rxBuf[26], rxBuf[27]);
48             temperatureF /= 10;
49             humidity = make16(rxBuf[30], rxBuf[31]);
50             humidity /= 10;
51             pressure = make16(rxBuf[34], rxBuf[35]);
52             pressure /= 100;
53             printf("TempF = %3.2fF\r\n", temperatureF);
54             printf("Humidity = %3.2f%\r\n", humidity);
55             printf("Barometric Pressure = %3.2fHg\r\n", pressure);
56         }
57         gpioSleep(PI_TIME_RELATIVE, 1, 0); //delay 1 second
58     }while(1);
59 }

```

Thank you for attending

Please consider the resources below:

- <https://www.raspberrypi.org>
- <https://ubuntu.com>
- <https://www.eclipse.org>
- <https://mikroe.com>



Thank You

Sponsored by

