



DesignNews

Raspberry Pi 5 Automation Lecture Series

Day 2:

Attaching Sensors to the Raspberry Pi 5

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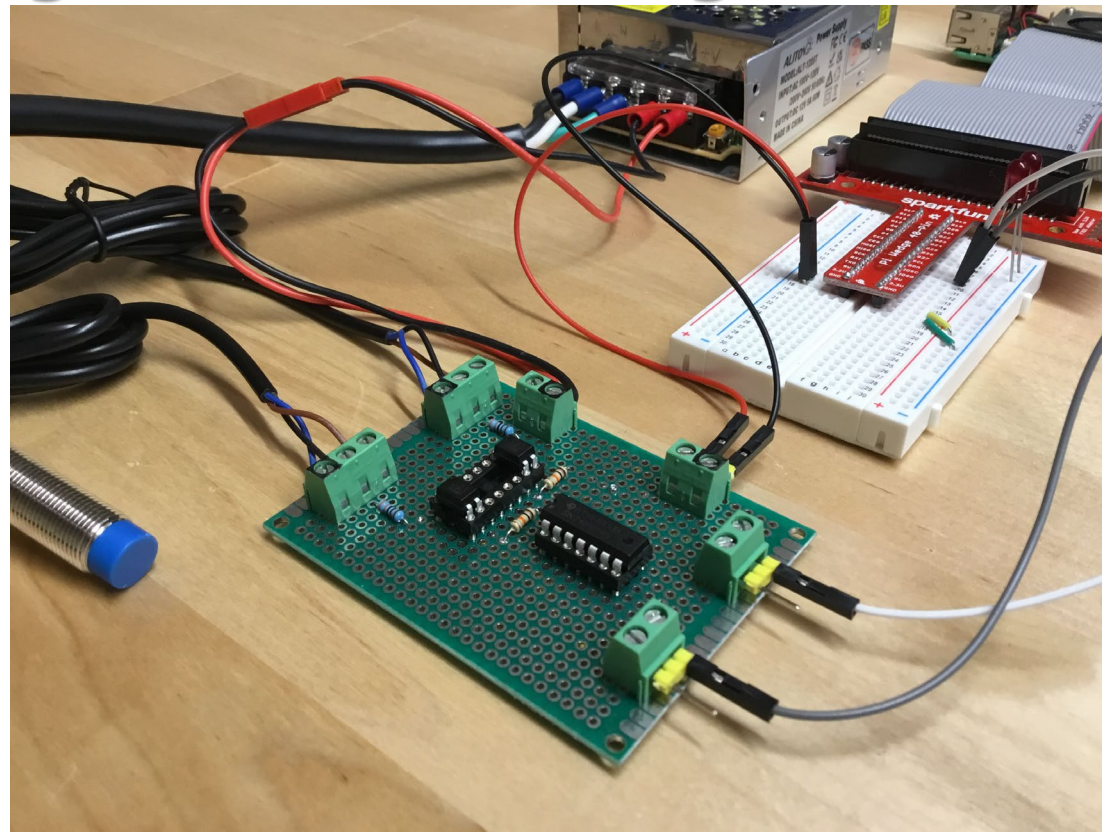


Fred Eady

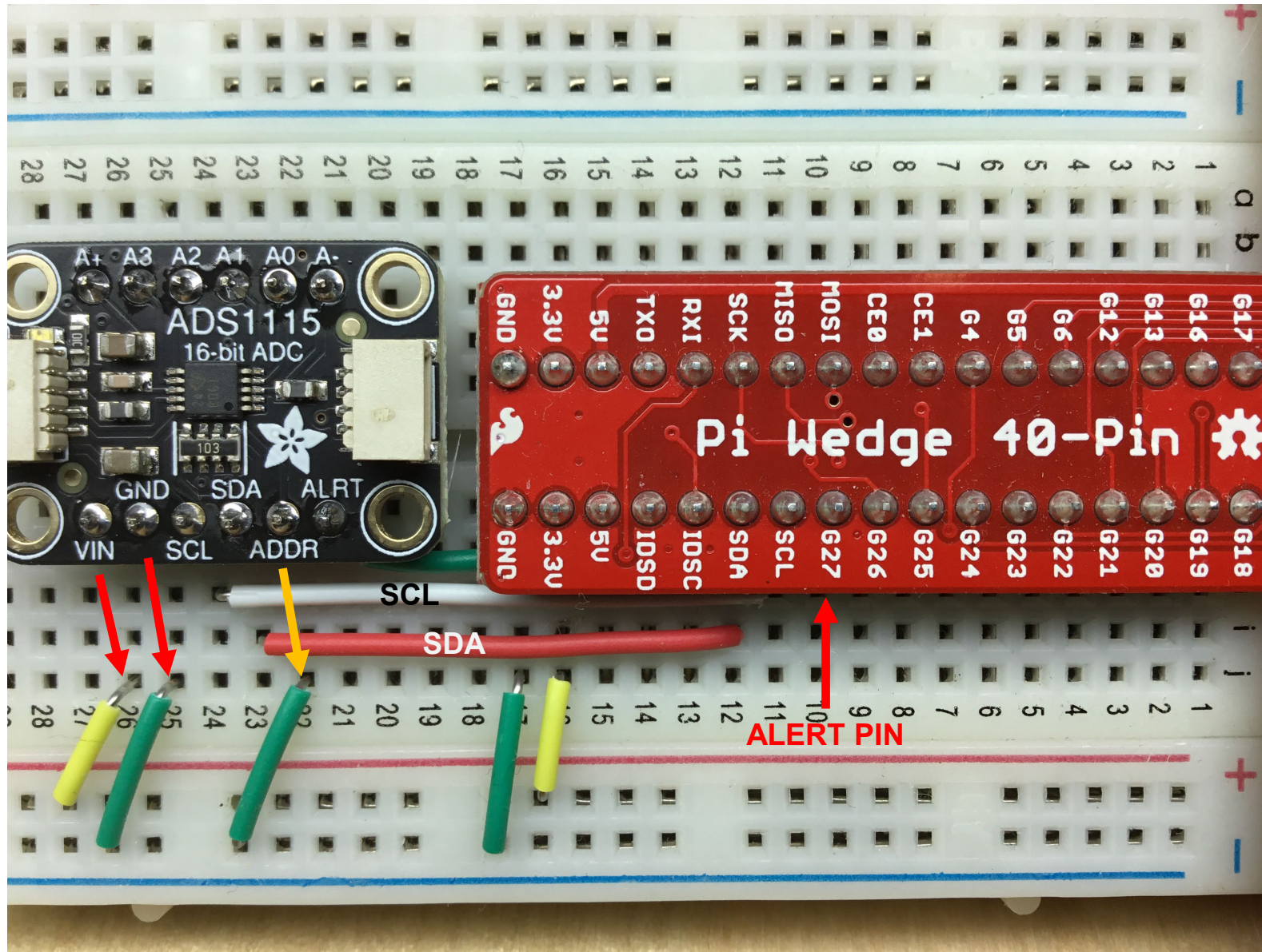
Visit 'Lecturer Profile' in your console for more details.

AGENDA

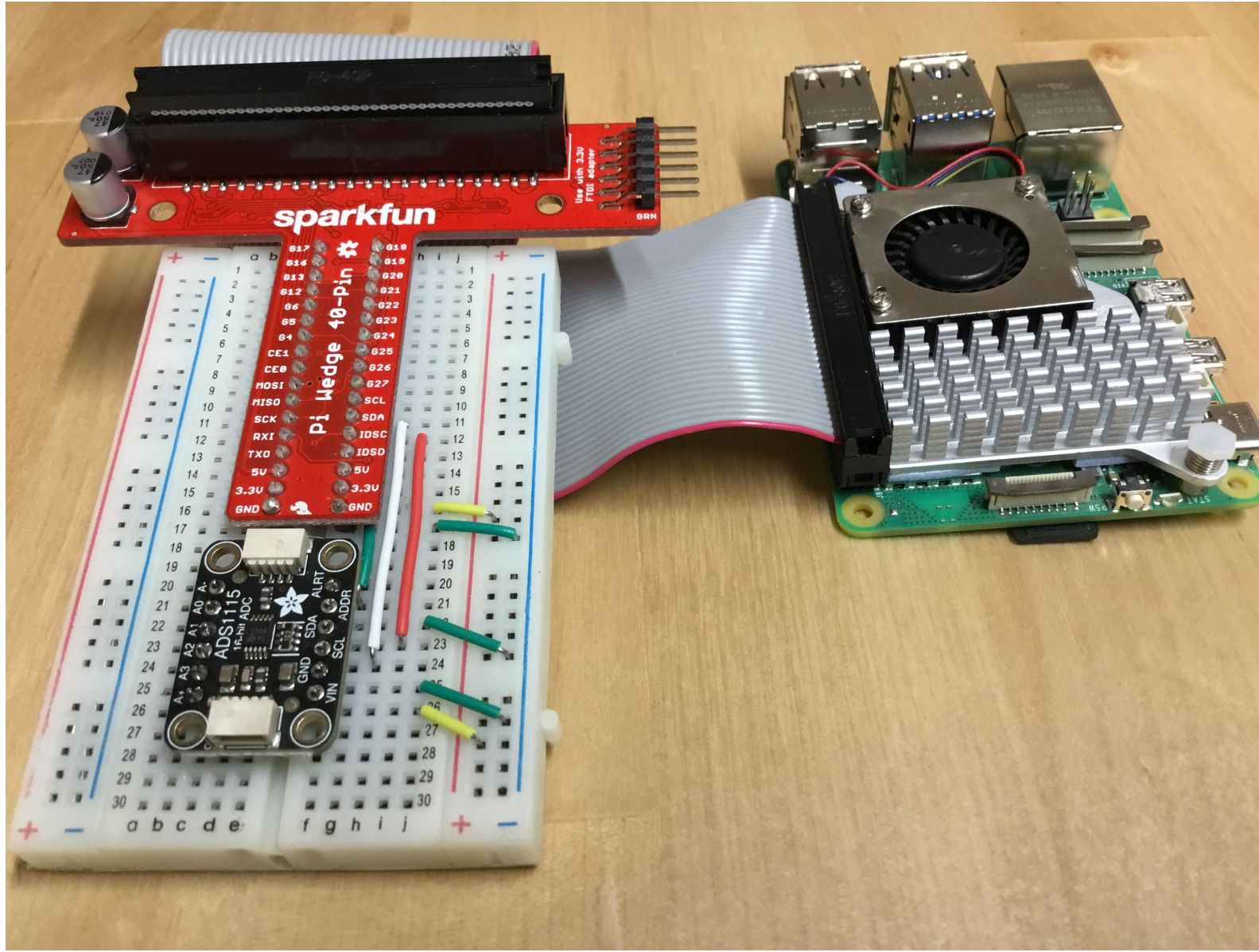
- **Install a 16-Bit Raspberry Pi 5 Analog-to-Digital Interface**
- **Code a Raspberry Pi 5 TCP/IP Client Sensor Node**
- **Construct a Pico W TCP/IP Server Sensor Node**
- **Construct an Upgraded Electromagnetic Sensor Interface**



Wire Up the ADC Hardware



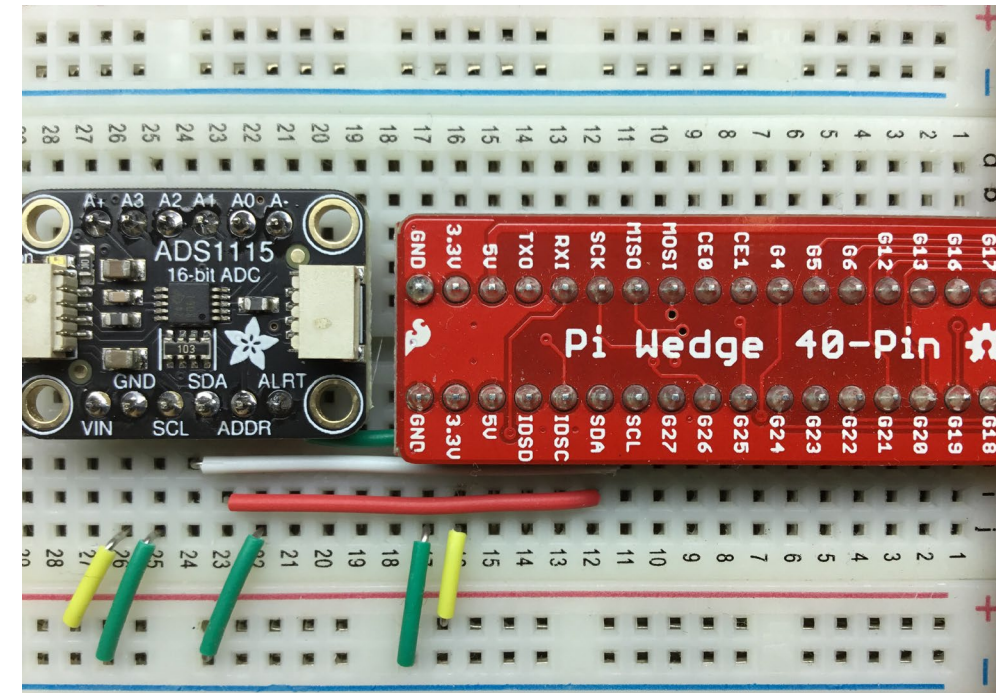
Wire Up the ADC Hardware



Contact and Setup the ADS1115

```
int main(int argc, char *argv[])
{
int h;
int err;
ads1x15_p adc=NULL;
double end_time;

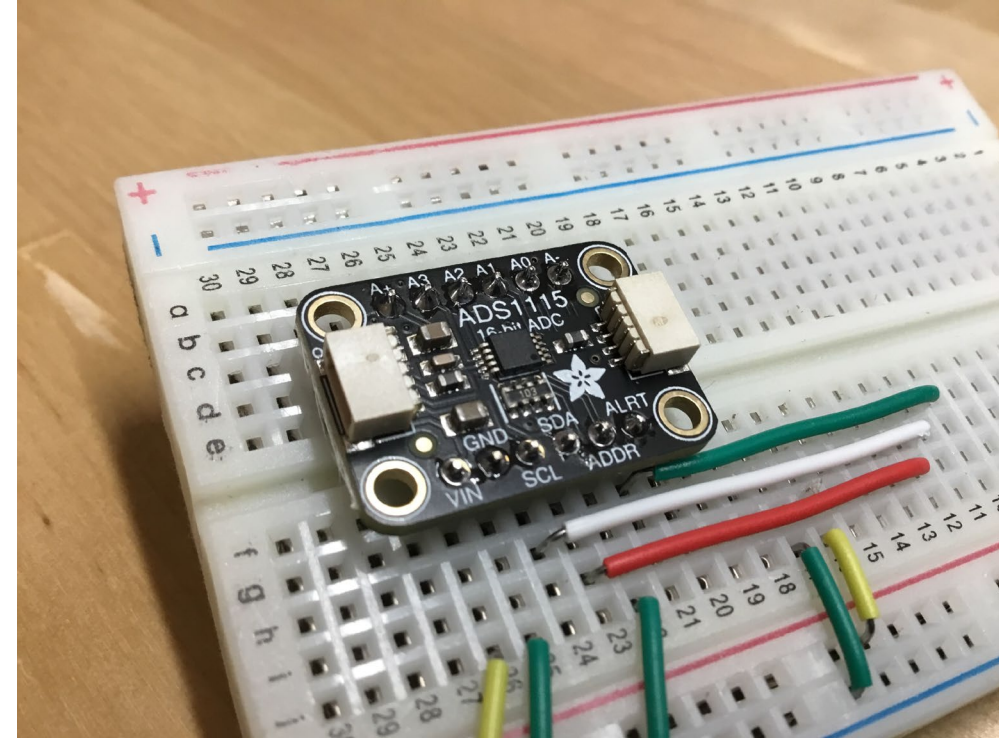
adc = ADS1115_open(0, 1, 0x48, 0);
printf("ADS1115 is active!!\r\n");
if (adc == NULL)
{
printf("ERROR: ADS1115 failed to open..\r\n");
return -2;
}
ADS1X15_set_channel(adc, ADS1X15_A0);
ADS1X15_set_voltage_range(adc, 3.3);
ADS1X15_set_sample_rate(adc, 0); // set minimum sampling rate
ADS1X15_alert_when_high_or_low(adc, 3, 1); // alert outside these voltages
```



Setup the GPIO ALERT Mechanism

```
if (alertPin >= 0)
{
    h = lgGpiochipOpen(4);
    printf("Gpiochip opened!! Handle = %u\r\n",h);
    if (h < 0)
    {
        printf("ERROR: Gpiochip open failed..\r\n");
        return -3;
    }

    // open the GPIO for alerts
    err = lgGpioClaimAlert(h, 0, LG_BOTH_EDGES, alertPin, -1);
    if (err < 0) return -4;
    lgGpioSetAlertsFunc(h, alertPin, alert_cbf, adc);
}
```

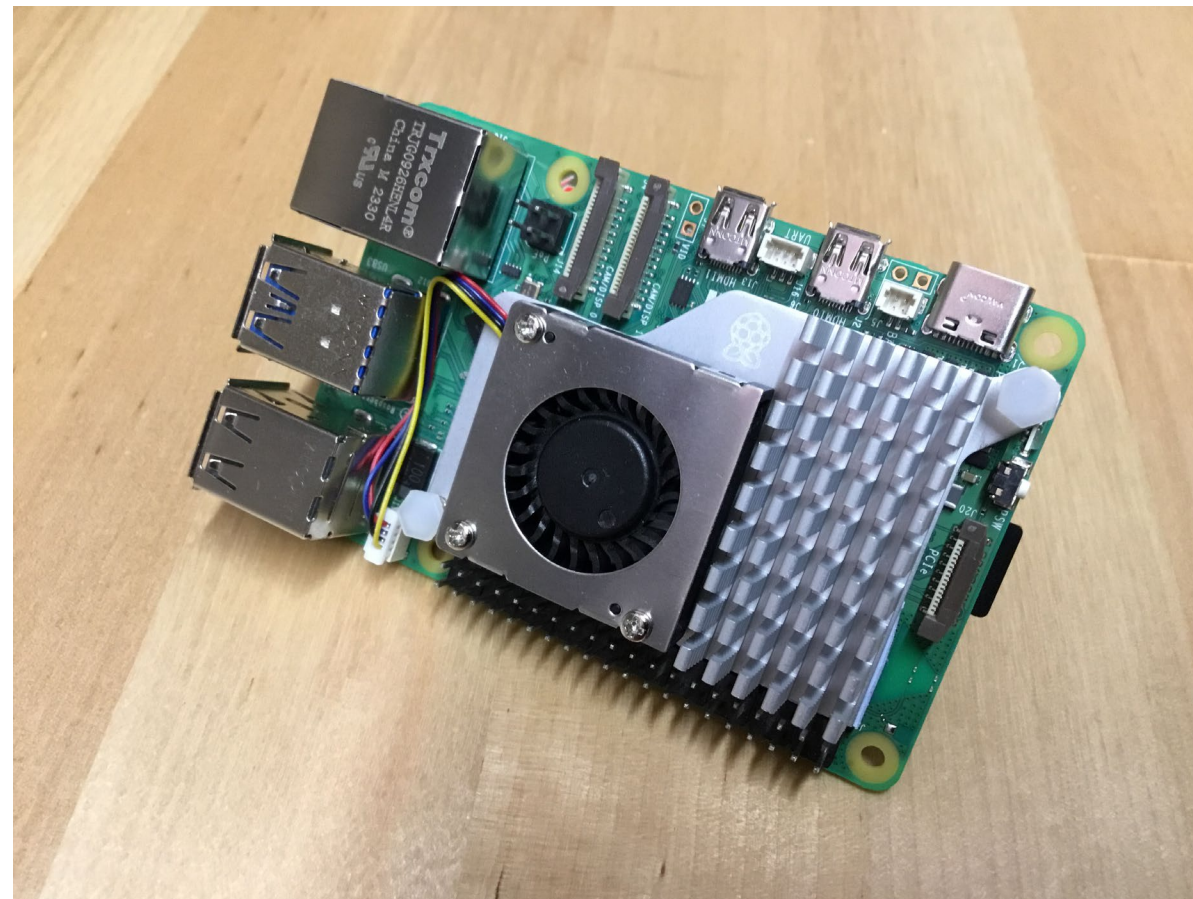


Create the Client Socket

```
void alert_cbf(int e, lgGpioAlert_p evt, void *userdata)
{
int socket_adc;
struct sockaddr_in server;
char alertMsg[32];
int adcRaw;

ads1x15_p adc = userdata;

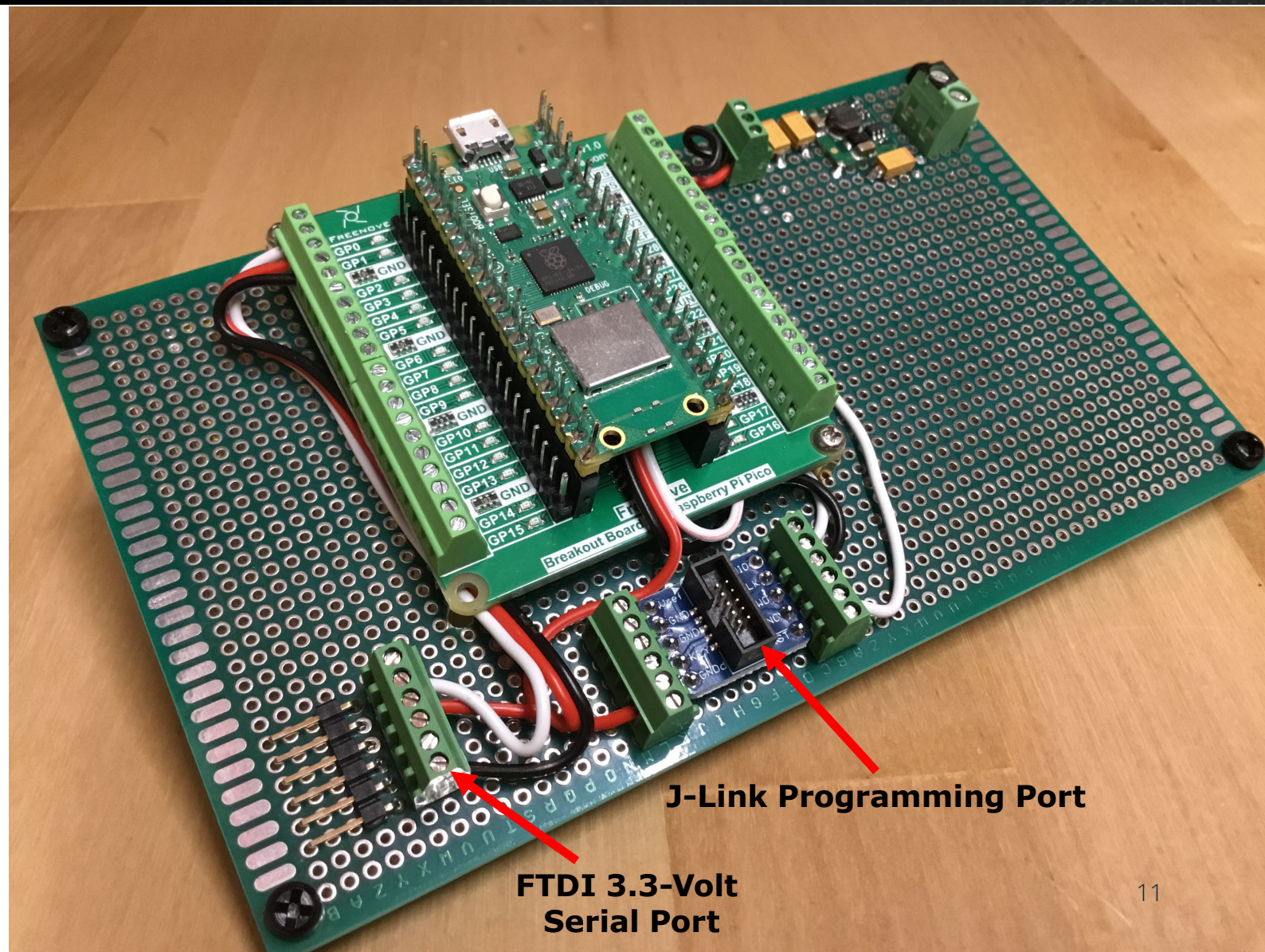
alertMsg[0] = 'A';
alertMsg[1] = 'L';
alertMsg[2] = 'E';
alertMsg[3] = 'R';
alertMsg[4] = 'T';
alertMsg[5] = ':';
//Create socket
socket_adc = socket(AF_INET , SOCK_STREAM , 0);
if (socket_adc == -1) printf("Could not create socket");
```

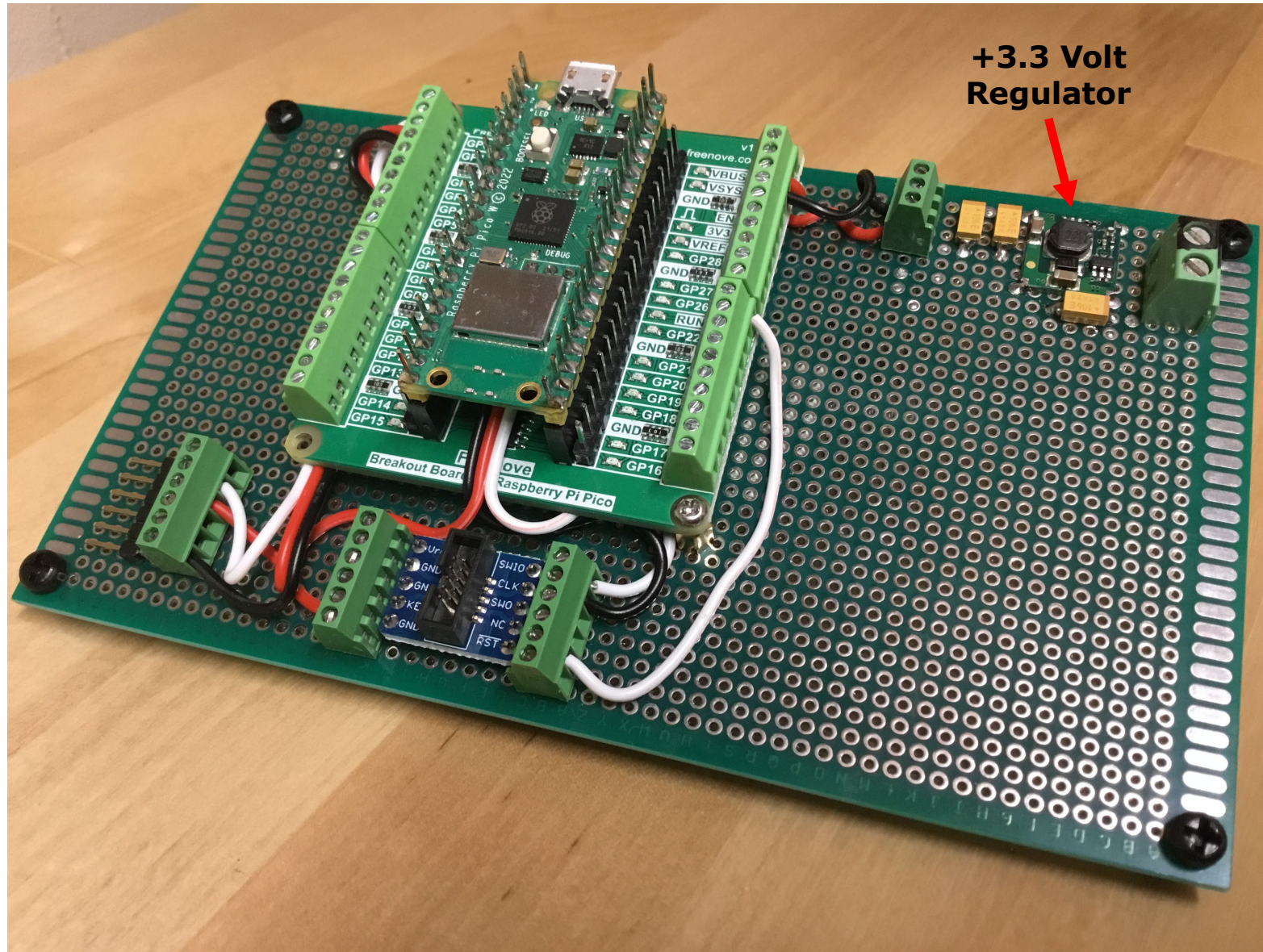


Connect to the Server and Send the ALERT Packet

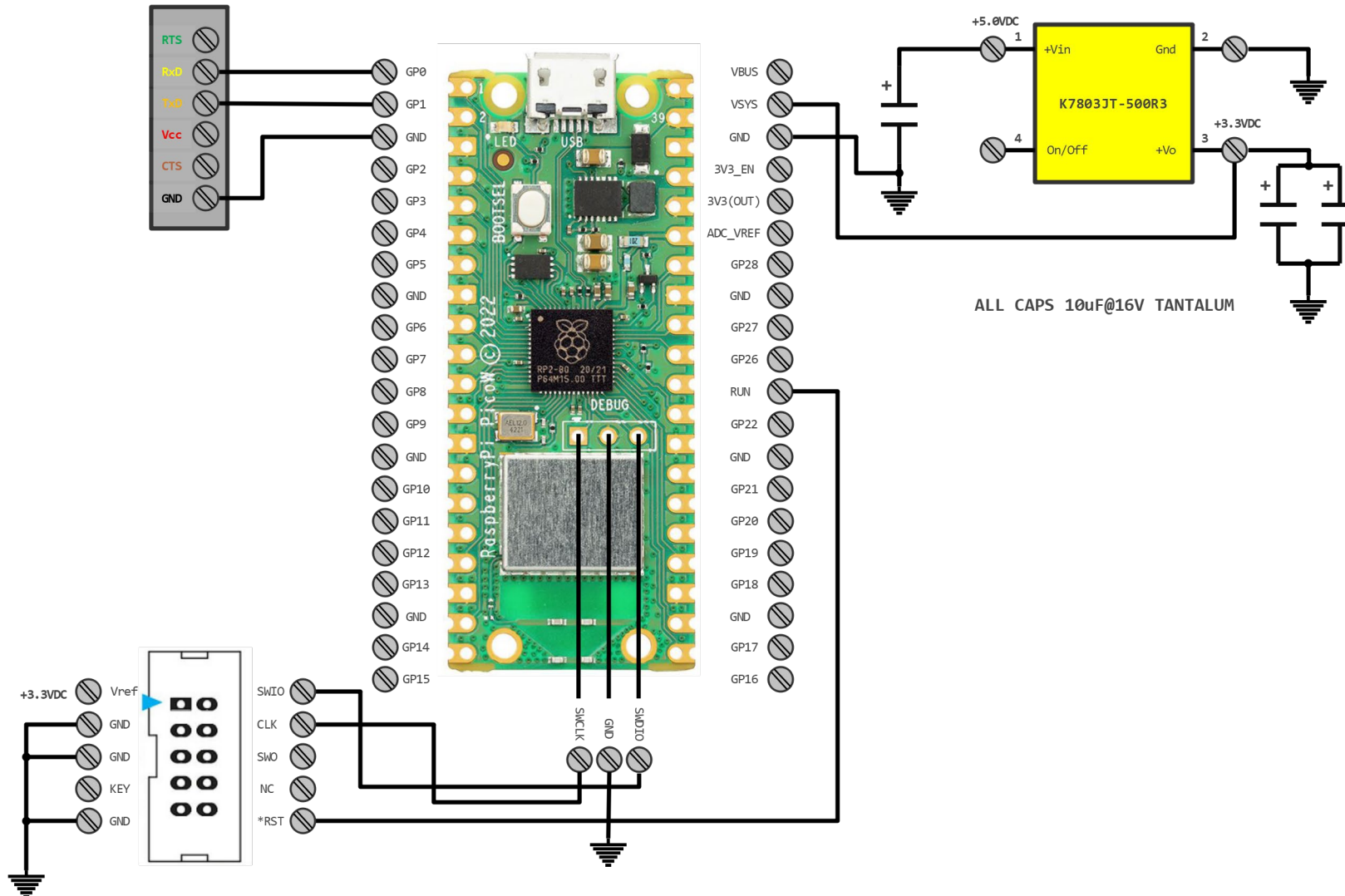
```
server.sin_addr.s_addr = inet_addr("192.168.1.129");
server.sin_family = AF_INET;
server.sin_port = htons( 8088 );
//Connect to remote server
if (connect(socket_adc , (struct sockaddr *)&server , sizeof(server)) < 0){
puts("connect error");
return;
}
adcRaw = ADS1X15_read(adc);
alertMsg[6] = (adcRaw & 0xFF00) >> 8;
alertMsg[7] = adcRaw & 0x00FF;
alertMsg[8] = '\r';
if( send(socket_adc , alertMsg , strlen(alertMsg) , 0) < 0){
puts("Send failed");
return;
}
close(socket_adc);
}
```


PICO W TCP/IP Server Hardware



PICO W TCP/IP Server Hardware

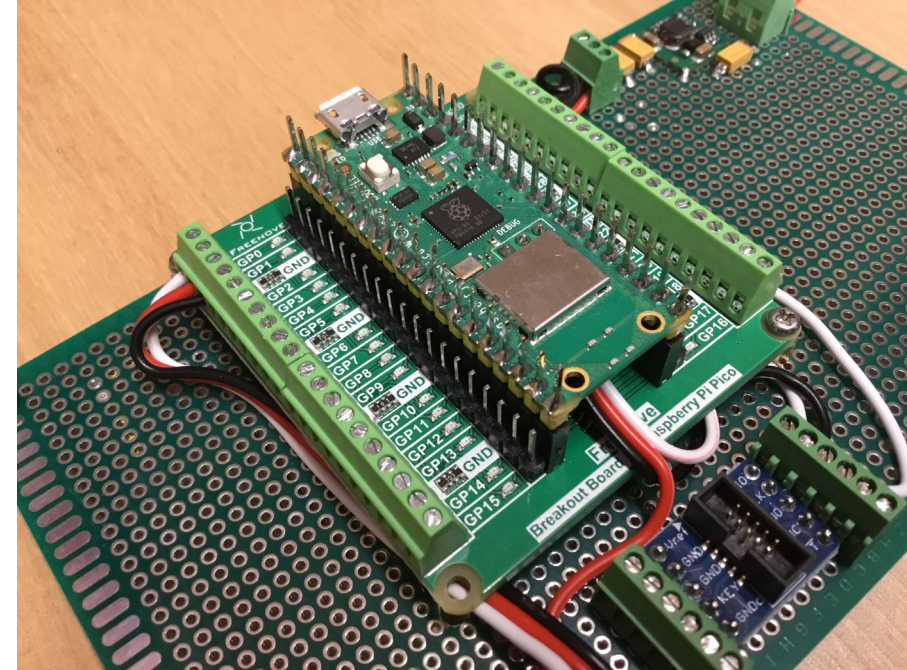
PICO W TCP/IP Server Hardware



Listen and Connect to the Raspberry Pi 5 Client

```
static int handle_alert(int conn_sock)
{
    char buffer[16];
    char bufalert[16];
    int done = 0;
    int i;
    int indx, position, len;
    memset(buffer, 0x00, sizeof(buffer));
    memset(bufalert, 0x00, sizeof(bufalert));

    while (done < sizeof(buffer))
    {
        int done_now = recv(conn_sock, buffer + done, sizeof(buffer) - done, 0);
        if (done_now <= 0)
            return -1;
        done += done_now;
        char *end = strstr(buffer, "\r", done);
        if (!end)
            continue;
        *end = 0;
    }
}
```



NOTE:

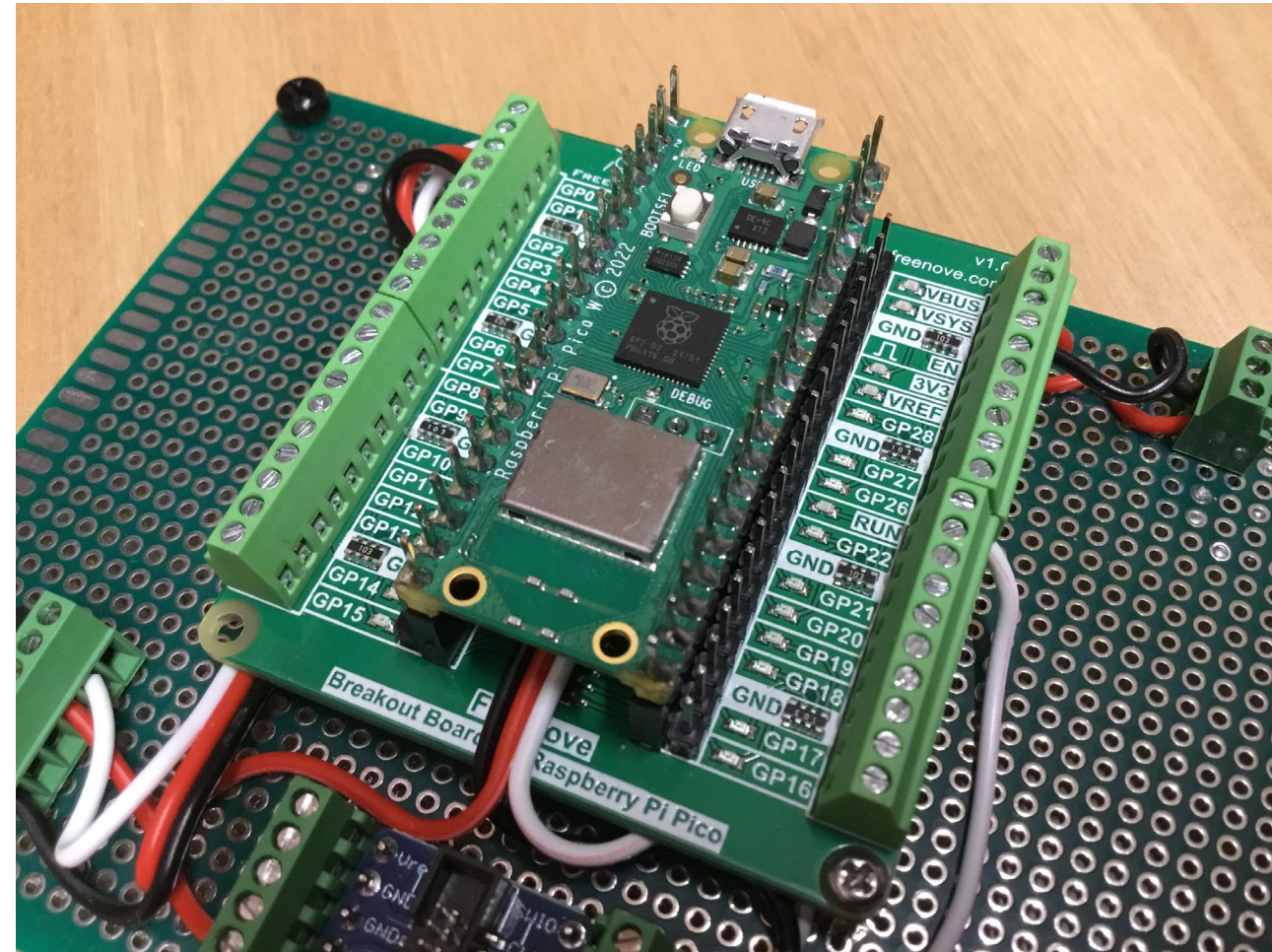
done is the length of the received packet

***end** is a pointer to “\r”

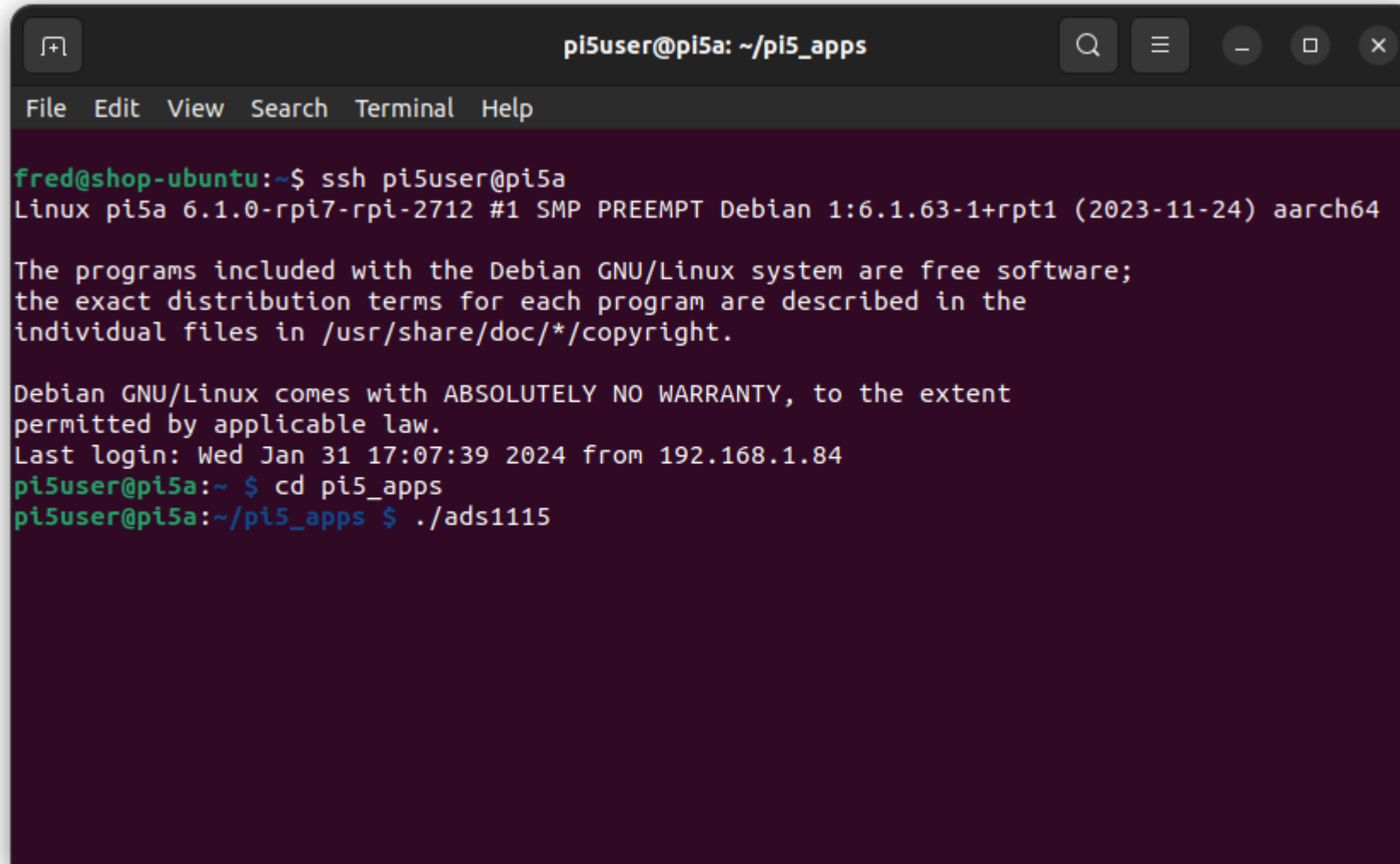
end is the value of “\r”

Parse the ALERT Packet

```
indx = 0;
position = 1;
len = 6; // Length of "ALERT:"
while(indx < len)
{
    bufalert[indx] = buffer[position + indx -1];
    indx++;
}
if (!strcmp(bufalert, "ALERT:"))
{
    cyw43_arch_gpio_put(0, true);
    printf("The LED is now on\r\n");
}
else
{
    printf("no match\r\n");
}
break;
}
```



Start the Raspberry Pi 5 TCP/IP Client Sensor Node



```
pi5user@pi5a: ~/pi5_apps
File Edit View Search Terminal Help

fred@shop-ubuntu:~$ ssh pi5user@pi5a
Linux pi5a 6.1.0-rpi7-rpi-2712 #1 SMP PREEMPT Debian 1:6.1.63-1+rpt1 (2023-11-24) aarch64

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: Wed Jan 31 17:07:39 2024 from 192.168.1.84
pi5user@pi5a:~ $ cd pi5_apps
pi5user@pi5a:~/pi5_apps $ ./ads1115
```


Receive and Process an ALERT Packet

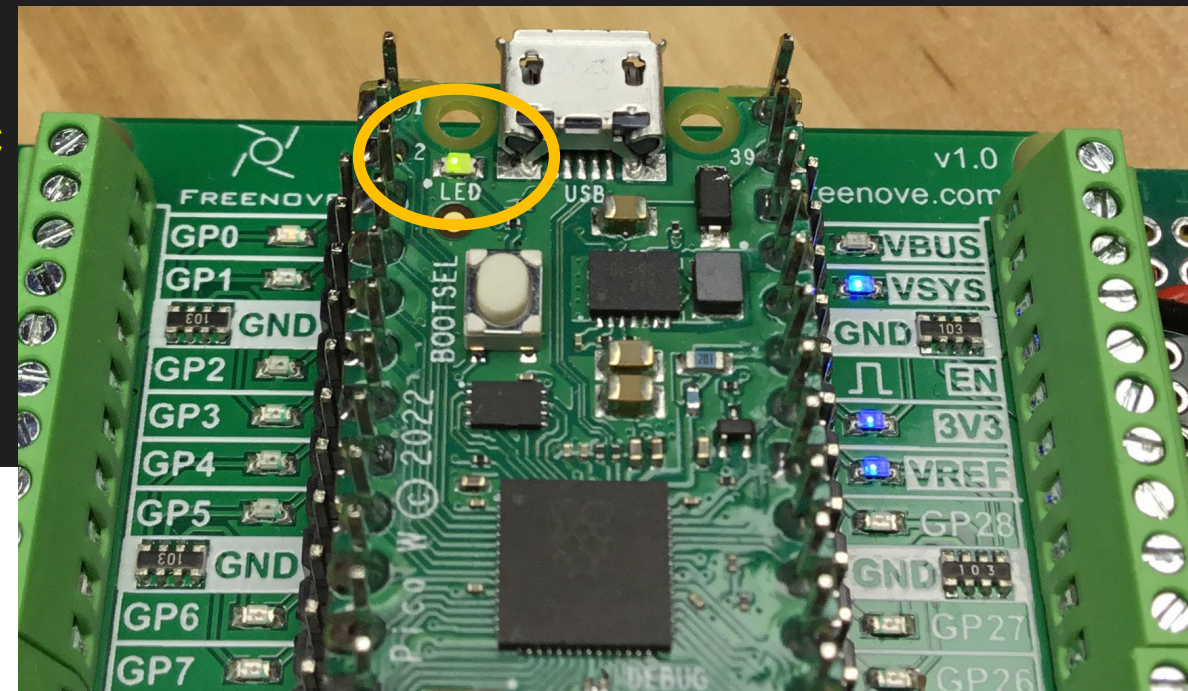
Monitor Mode Serial View Mode Text Port /dev/ttyUSB0 - FTDI Baud rate 115200 Line ending CRLF Stop Monitoring

```
Version: 7.95.49 (2271bb6 CY) CRC: b7a28ef3 Date: Mon 2021-11-29 22:50:27 PST Ucode Ver: 1043.2162 FWID 01-c51d9400
cyw43 loaded ok, mac 28:cd:c1:09:5c:e9
API: 12.2
Data: RaspberryPi.PicoW
Compiler: 1.29.4
ClmImport: 1.47.1
Customization: v5 22/06/24
Creation: 2022-06-24 06:55:08
```

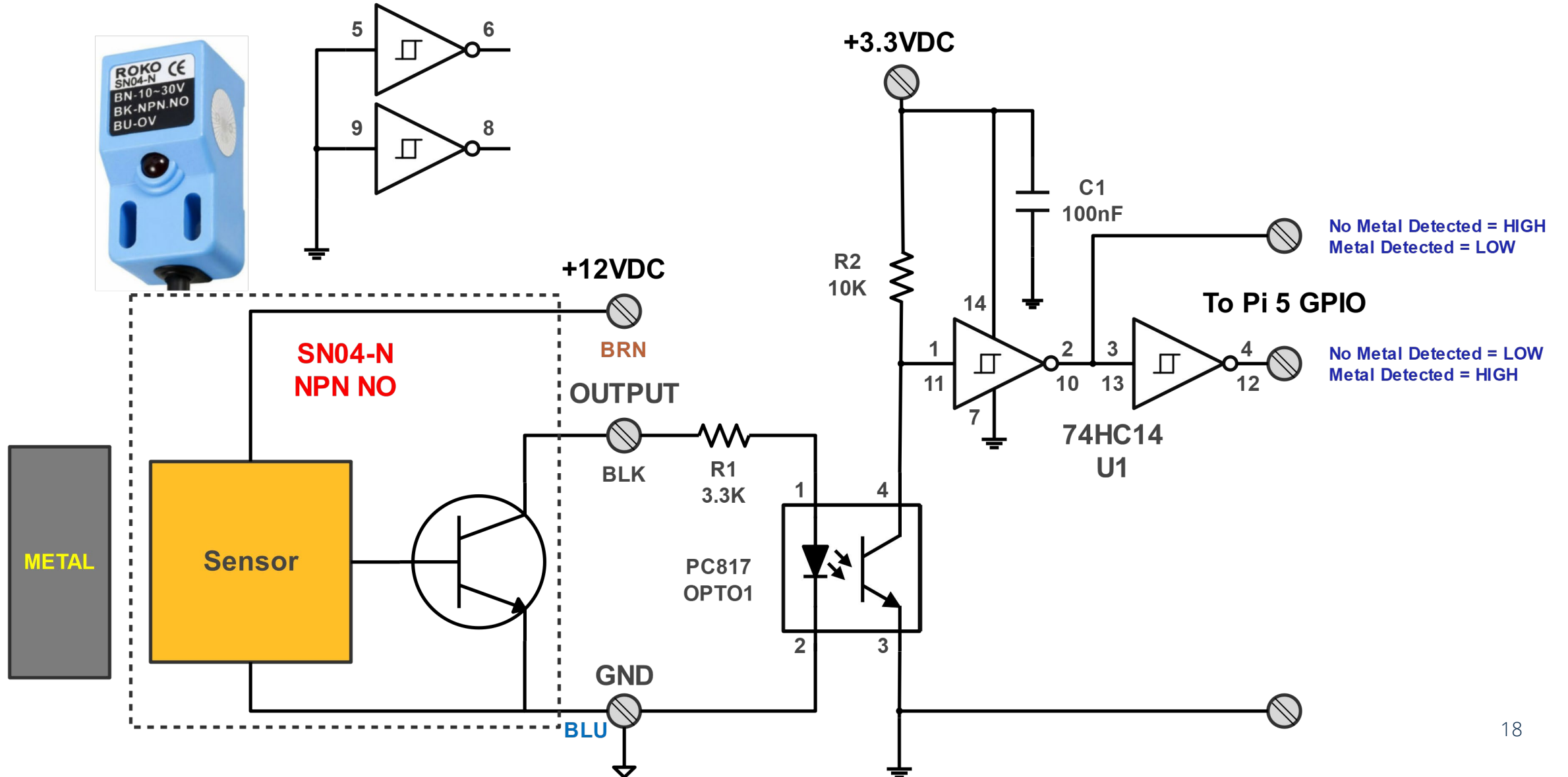
```
Connecting to WiFi...
connect status: joining
connect status: no ip
connect status: link up
Connected.
Starting server at 192.168.1.129 on port 8088
41 4C 45 52 54 3A 1F 32 00 1A 49 3C 56 55 00 00
41 4C 45 52 54 3A 00 00 00 00 00 00 00 00 00 00
The LED is now on
```

Incoming Alert Packet
Voltage = 0x1F32 = +0.998VDC

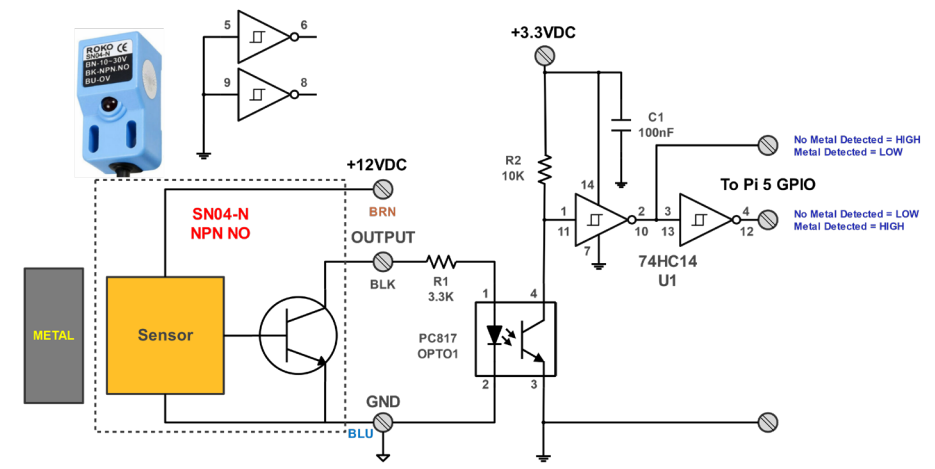
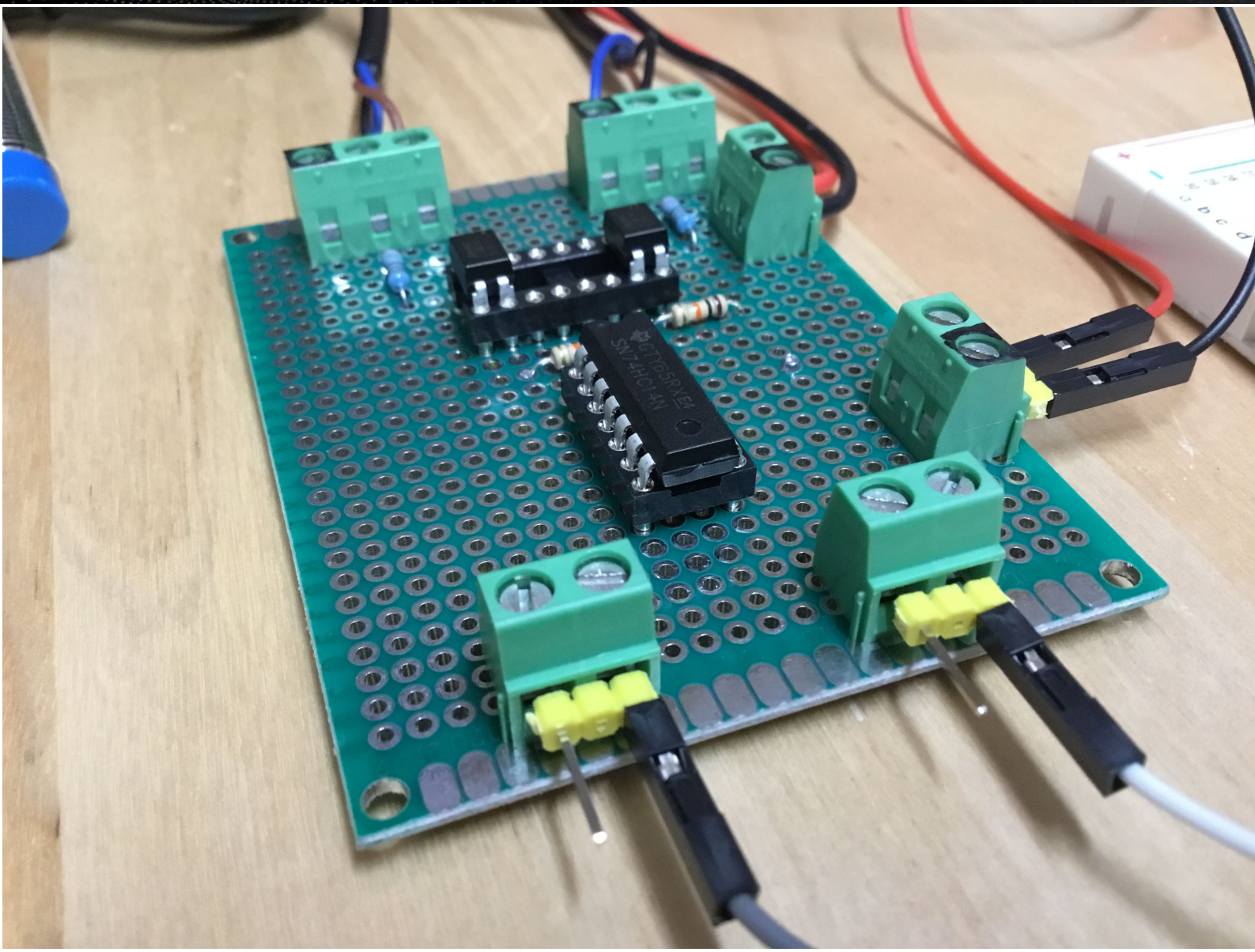
```
41 4C 45 52 54 3A 1F 32 00
A L E R T : 1F 32 00
```



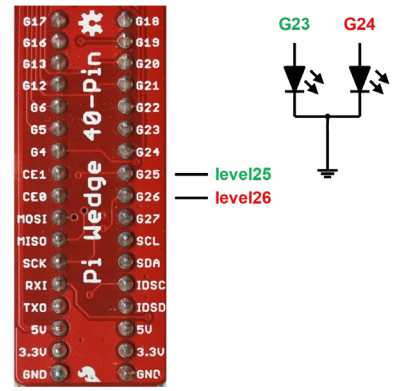
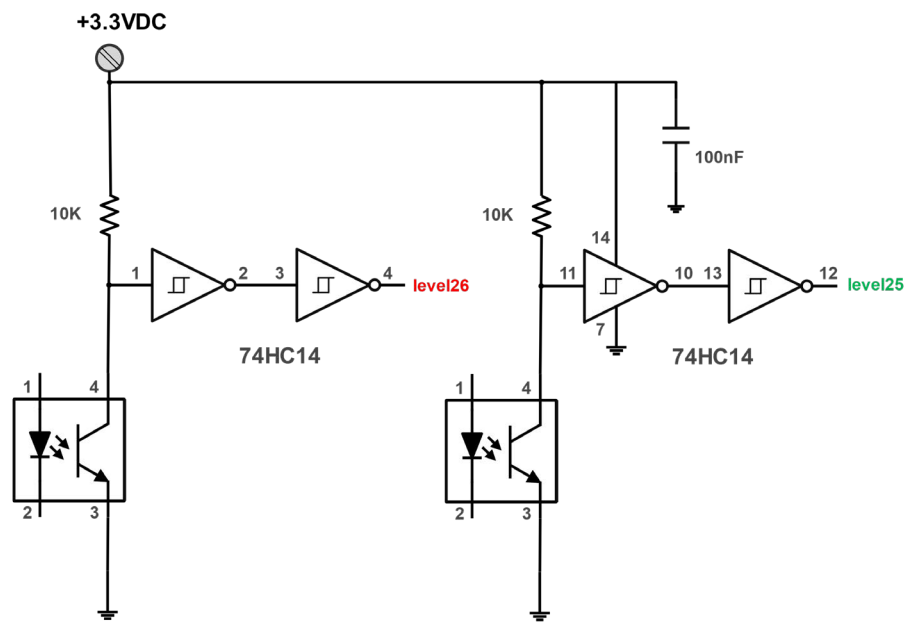
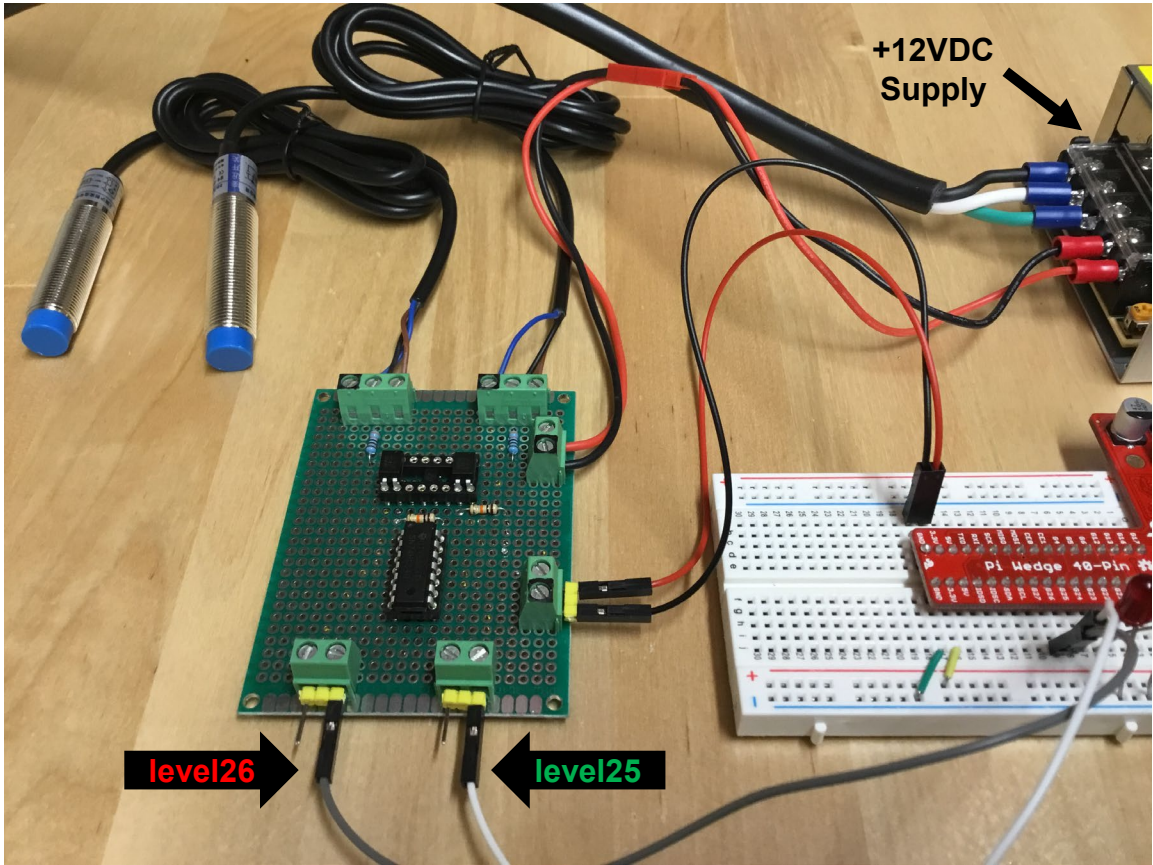
Improved Electromagnetic Sensor Interface



Improved Electromagnetic Sensor Interface



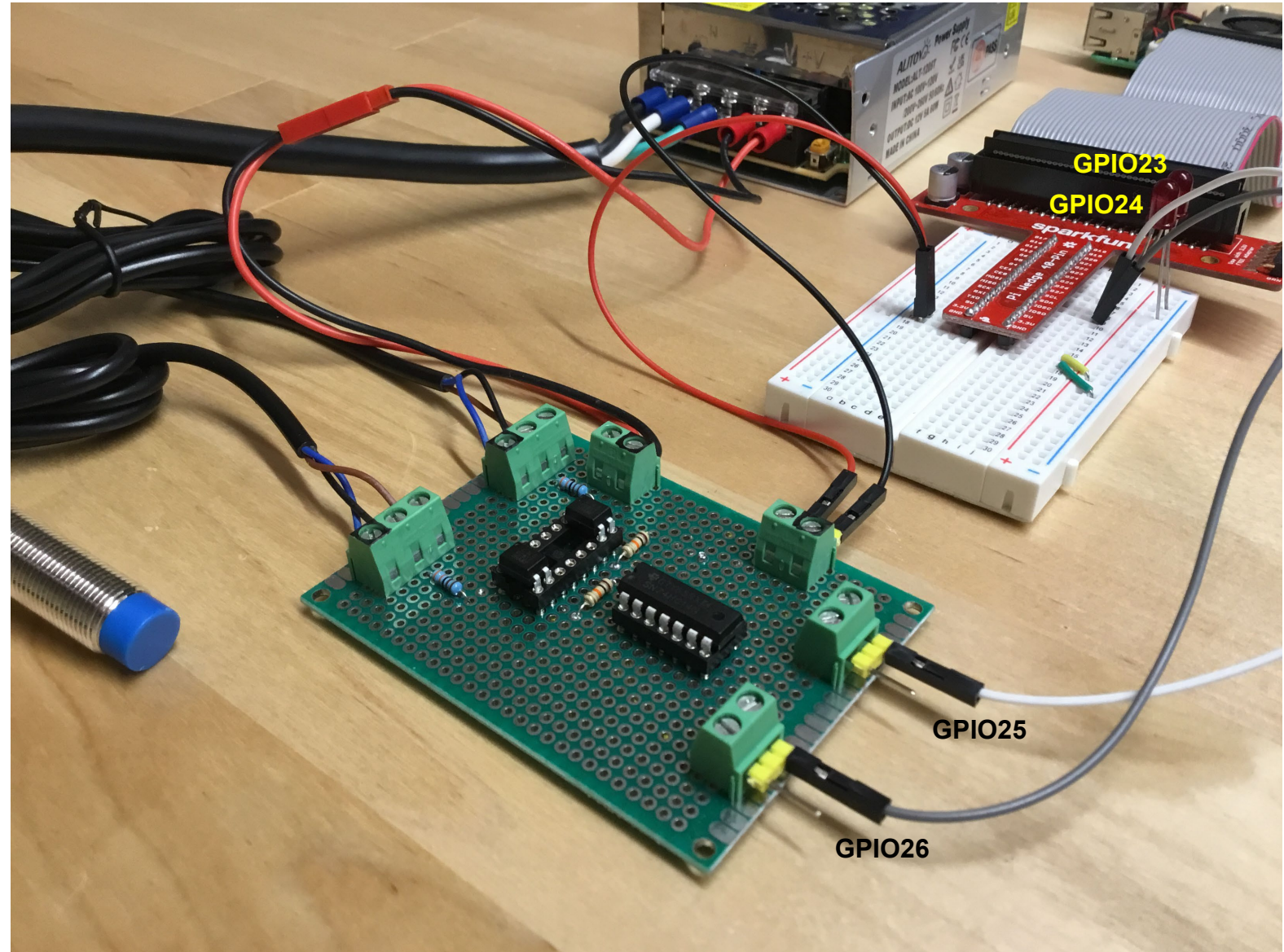
Electromagnetic Sensor System View



Setup Raspberry Pi 5 GPIO

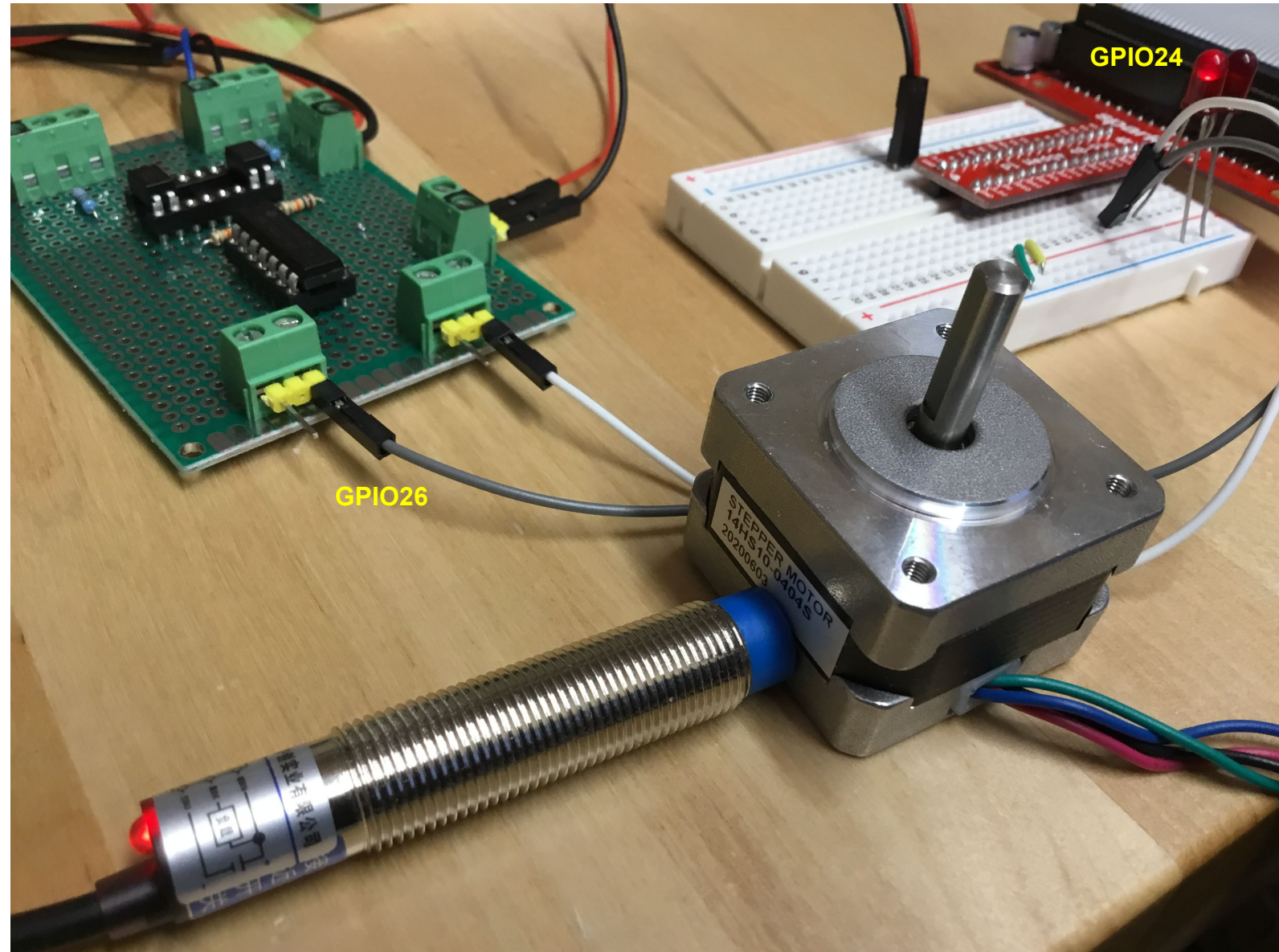
```
int h,i;  
uint8_t level25;  
uint8_t level26;
```

```
int main(void)  
{  
h = lgGpiochipOpen(4);  
lgGpioClaimOutput(h,0,23,0);  
lgGpioClaimOutput(h,0,24,0);  
lgGpioClaimInput(h,0,25);  
lgGpioClaimInput(h,0,26);
```



Metal Detected on GPIO 26

```
while(1)
{
  level25 =lgGpioRead(h,25);
  switch(level25)
  {
  case 0x00:
    lgGpioWrite(h,23,0);
    break;
  case 0x01:
    lgGpioWrite(h,23,1);
    break;
  }
  level26 =lgGpioRead(h,26);
  switch(level26)
  {
  case 0x00:
    lgGpioWrite(h,24,0);
    break;
  case 0x01:
    lgGpioWrite(h,24,1);
    break;
  }
}
```



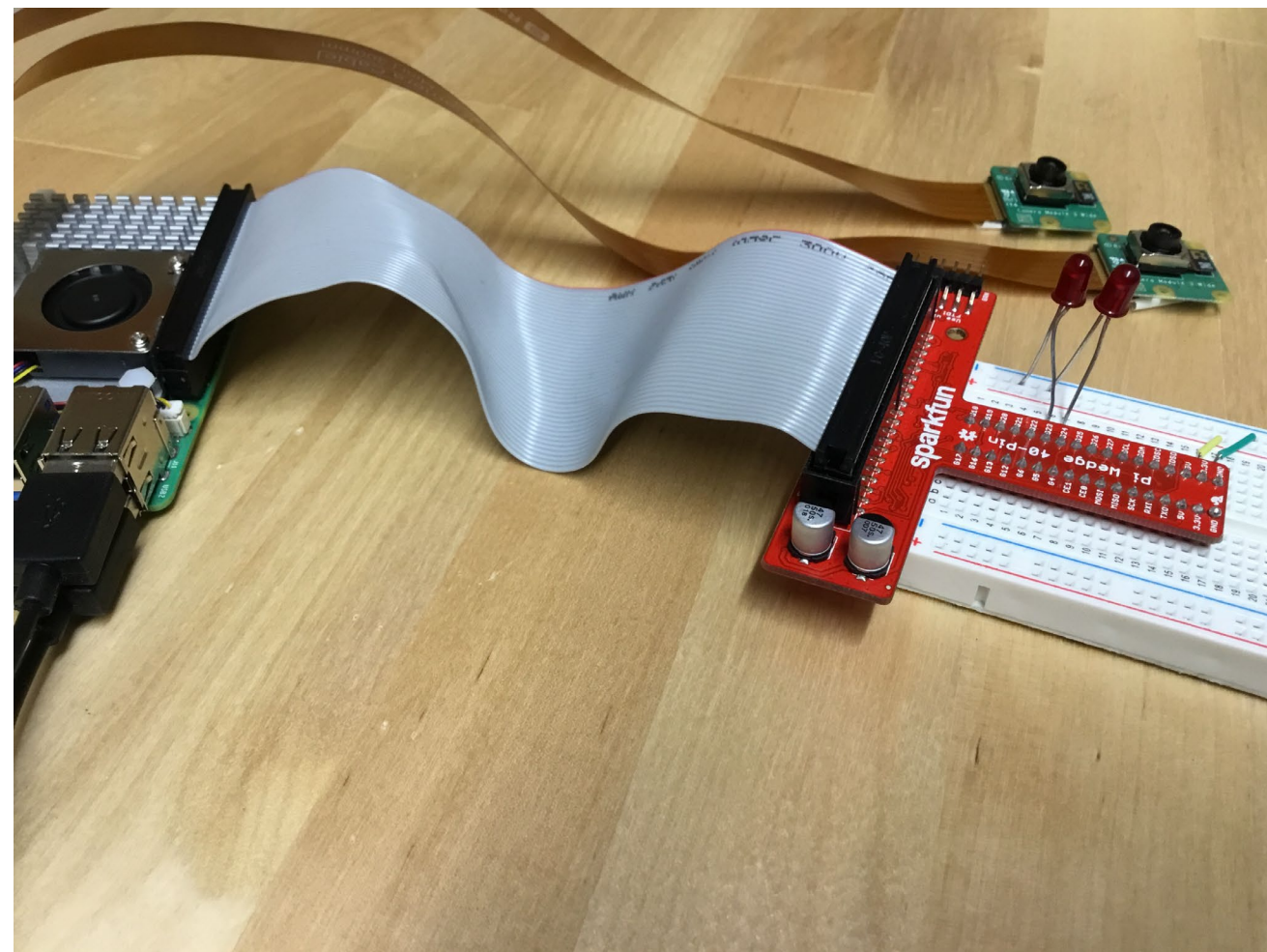
Next Time...

MORE TO COME..

Thank you for attending!!!

Please consider the resources below:

- [Today's Download Package](#)
- [raspberrypi.org – Raspberry Pi 5](#)
- [raspberrypi.org – PICO W](#)
- [LJ12A3-4-Z/BX Datasheet](#)





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