



# K210+MLX90640红外热像仪

作者: neucrack

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阅读: 6877

点赞: 72

难度: ★★★☆☆



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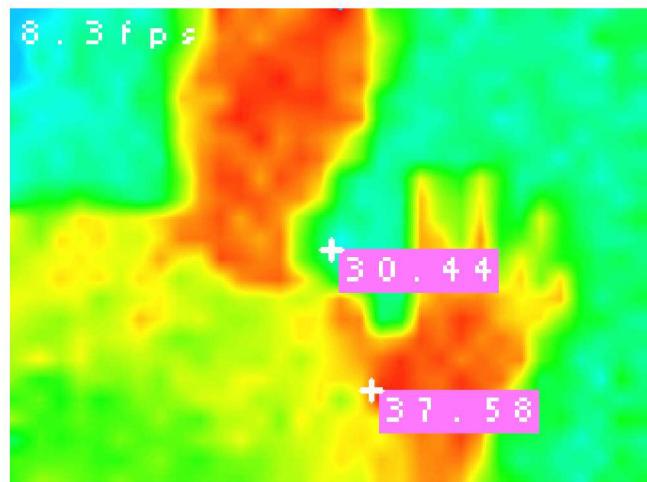
# 使用 K210 + MLX90640 实现热像仪功能, 实时无接触测量温度, `MaxiPy` 和 `CPython` 的简单实现

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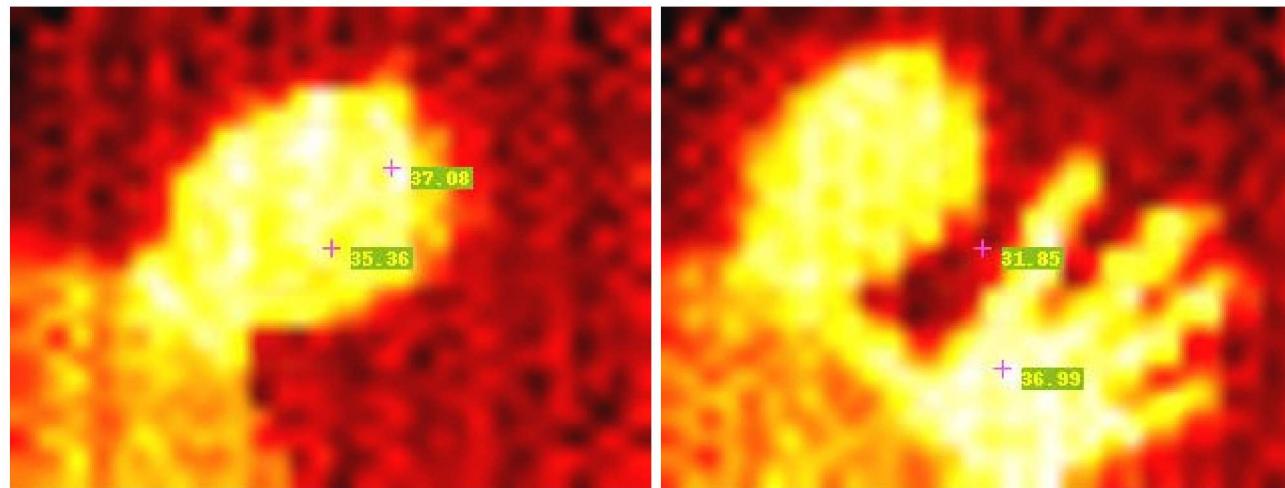
原文链接(持续更新) : <https://neucrack.com/p/189>

效果图:

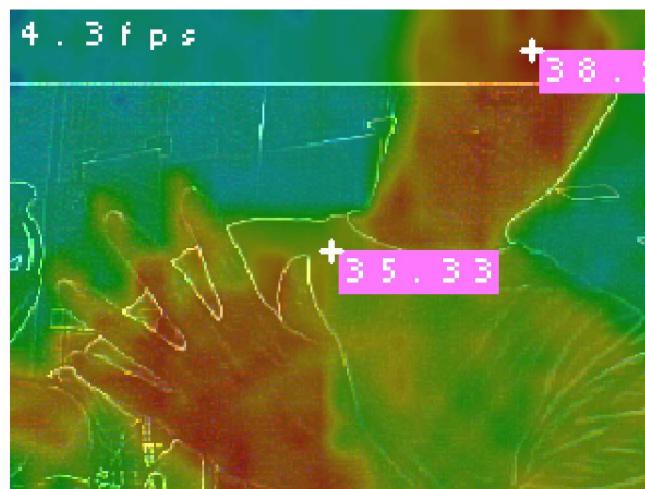
- K210 对图像画出了热力图, 并标记几个重要点(中心点和最高温)的温度



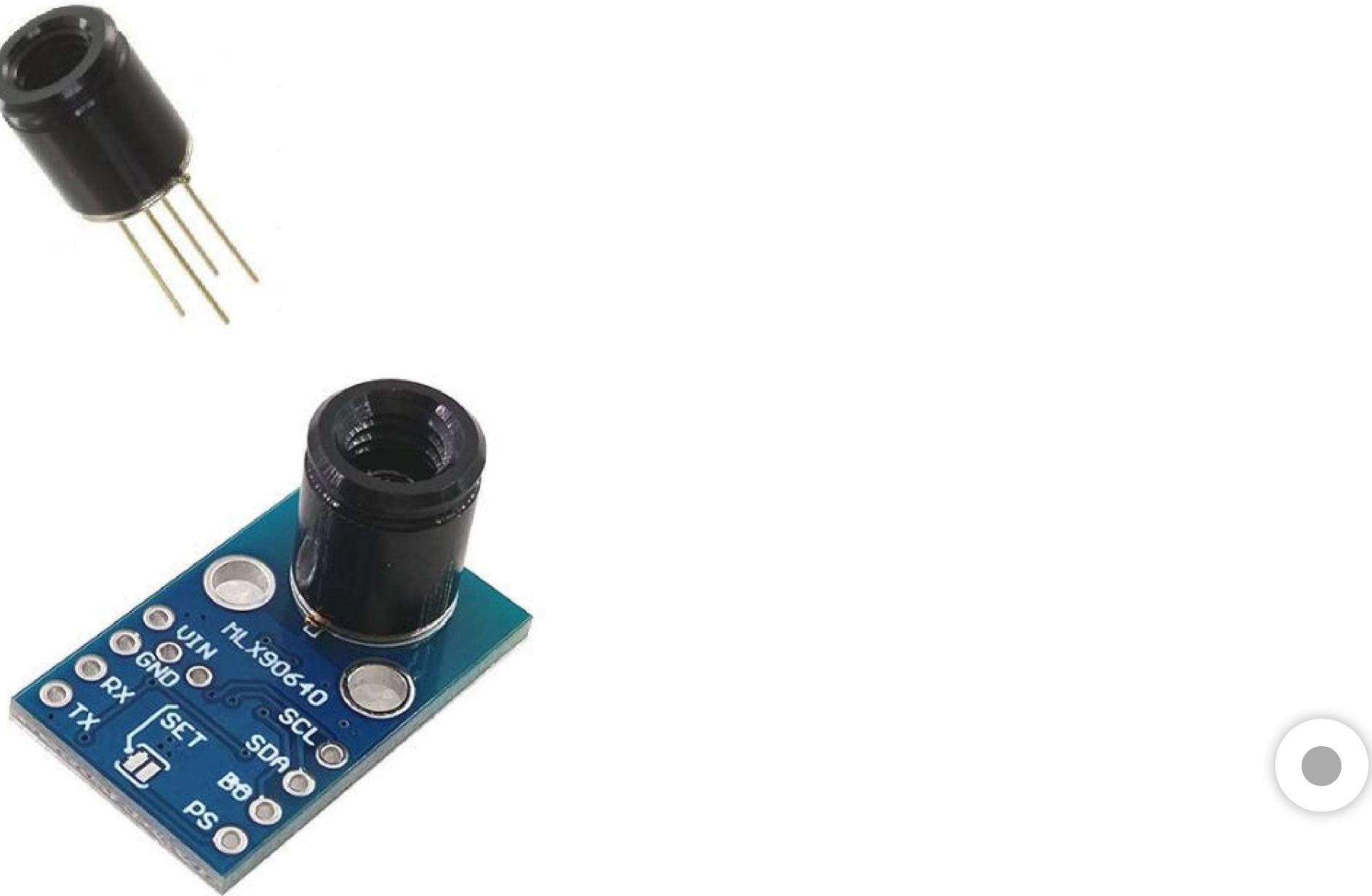
- PC Python 实现



- K210 与摄像头数据融合了的图



## 一、传感器及参数



几个关键参数如下,更多看芯片手册:

名称	参数
测量范围	-40° ~ 300°
分辨率	0.1°
测量精度	±2 ° 请参考芯片手册 47 页
重复精度	±2 °
响应频率	8 HZ (460800bps)
工作电压	3.3~5 V
工作电流	42mA
工作温度	-40° ~ 85°
尺寸	17.27mm×33mm

## 二、传感器驱动协议

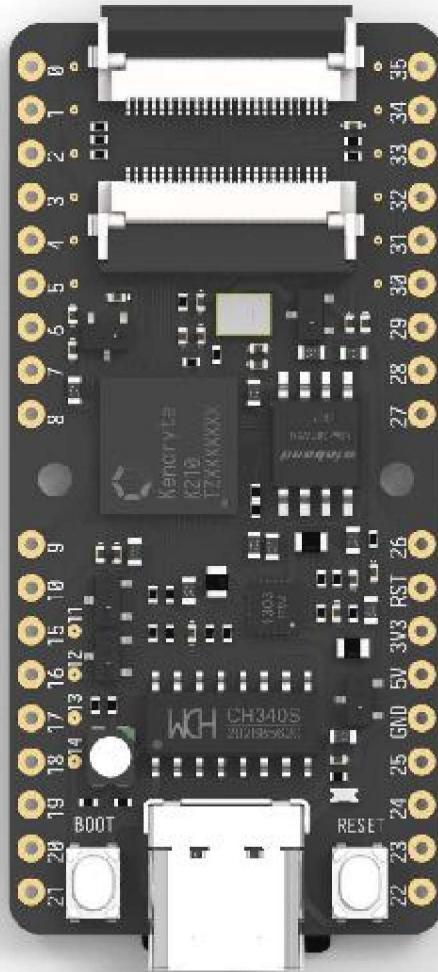
IIC ,也有模块加了块单片机做成了串口协议

### 三、主控芯片

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用 K210 ( RISC-V 双核,针对 AIOT 领域,能胜任本应用,而且使用 MaixPy ( Micropython )能快速实现看到效果





## 四、实现过程

- 获得硬件(**K210** 和 **MLX90640** (选用串口模块可以更快上手,这里用的也是串口模块))

- 下载 MaixPy 固件并测试运行通过(查看 [maixpy.sipeed.com](http://maixpy.sipeed.com) 获得教程)
- 驱动 MLX90640 ,由于是串口模块,只需要接收输出的数据即可,协议看模块文档,非常简单;如果是 IIC 协议会复杂一点点,多花点时间就好了.  
然后我们会得到 32x24 的温度数据
- 然后用得到的 32x24 阵列的温度数据构造 Image 对象(这里需要将温度数据映射到[0,255]的数值,为了对比明显,最好从得到所有像素点的极端值比如[20°C,45°C],然后按比例映射到8bit灰度值空间[0,255]), 对图像进行基本的处理,比如放大(resize,插值),然后伪彩映射可以得到一张好看的图
- 后面这些部分就是锦上添花的了, 在图片上画十字来标记最高温度点以及可以在图片中心标记温度,这样方便读数
- 将摄像头数据和传感器图像融合,得到有轮廓的热力图, 摄像头图像需要经过边缘标记,然后根据两个摄像头(图像摄像头和红外成像摄像头)的相对位置调整一下摄像头图片的位置,使用偏移旋转放大缩小达到与热力图吻合的效果
- 然后显示到显示器即可

代码 (没有优化,比较粗糙,可以运行,上面的图片来自于下面程序的截图):

```

1. import lcd, image, sensor
2. from fpioa_manager import *
3. from machine import UART
4. import gc
5.
6. auto_color = True
7. max_temp_limit = 300      # max 300
8. min_temp_limit = 0        # min -40
9.
10. edge = (-1,-1,-1,-1,8,-1,-1,-1,-1)
11.
```

```
12. offset_x = 0
13. offset_y = 50
14. zoom = 1.2
15. rotate = 0
16.
17. START_FLAG = 0x5A
18. sensor_width = 32
19. sensor_height = 24
20. lcd_w = 320
21. lcd_h = 240
22.
23. fm.register(9, fm.fpioa.UART1_TX)
24. fm.register(10, fm.fpioa.UART1_RX)
25.
26. com = UART(UART.UART1, 460800, timeout=1000, read_buf_len=4096)
27.
28.
29. lcd.init()
30. sensor.reset()
31. sensor.set_pixformat(sensor.RGB565)
32. sensor.set_framesize(sensor.QVGA)
33.
34. clock = time.clock()
35.
36. find_frame_flag = False
37. while 1:
38.     clock.tick()
39.     if not find_frame_flag:
40.         data = 0
41.         flag_count = 0
42.         while 1:
43.             if com.any() <= 0:
```



```
44.         continue
45.         data = com.read(1)
46.         if int.from_bytes(data, 'little') == START_FLAG:
47.             flag_count += 1
48.             if flag_count == 2:
49.                 find_frame_flag = True
50.                 break
51.             else:
52.                 flag_count = 0
53.         else:
54.             find_frame_flag = False
55.             max_temp_pos=None
56.             data = com.read(2)
57.             data_len = int.from_bytes(data[:2], "little")
58.             sum = START_FLAG * 256 + START_FLAG + data_len
59.             if auto_color:
60.                 min_temp = max_temp_limit
61.                 max_temp = min_temp_limit
62.                 data = com.read(data_len-2)
63.                 target_temp = []
64.                 for i in range(data_len//2-1):
65.                     v = int.from_bytes(data[i*2:i*2+2], 'little')
66.                     sum += v
67.                     v = v/100.0
68.                     if auto_color:
69.                         if v < min_temp:
70.                             if v < min_temp_limit:
71.                                 min_temp = min_temp_limit
72.                             else:
73.                                 min_temp = v
74.                         if v > max_temp:
75.                             if v > max_temp_limit:
```



```
76.             min_temp = max_temp_limit
77.         else:
78.             max_temp = v
79.             max_temp_pos = (i%sensor_width, i//sensor_width)
80.             target_temp.append( v )
81.     data = com.read(2)
82.     v = int.from_bytes(data, 'little')
83.     sum += v
84.     machine_temp = v/100.0
85.     data = com.read(2)
86.     parity_sum = int.from_bytes(data, 'little')
87.     if len(target_temp) != sensor_height*sensor_width:
88.         print("err")
89.         continue
90. # print("{:02x} {:02x}".format(parity_sum, sum%0xffff))
91. # TODO: parity not correct according to the doc
92. # if parity_sum != sum%0xffff:
93. #     print("parity sum error")
94. #     continue
95. center_temp = target_temp[int(sensor_width/2 + sensor_height/2*sensor_width)]
96. # print("data length:", len(target_temp))
97. # print("machine temperature:", machine_temp)
98. # print("center temperature:", center_temp)
99. img = image.Image(size=(sensor_width, sensor_height))
100. img = img.to_grayscale()
101. if max_temp == min_temp:
102.     max_temp += 1
103. for i in range(sensor_height):
104.     for j in range(sensor_width):
105.         color = (target_temp[i*sensor_width+j]-min_temp)/(max_temp-min_temp)*255
106.         img[sensor_width*i + j] = int(color)
107. img = img.resize(lcd_w, lcd_h)
```

```
108.     del target_temp
109.     img = img.to_rainbow(1)
110.     img2 = sensor.snapshot()
111.     img2.conv3(edge)
112.     img2 = img2.rotation_corr(z_rotation=rotate, x_translation=offset_x, y_translation=offset_y, zoom=zoom)
113.     img = img.blend(img2)
114.     del img2
115.     img = img.draw_rectangle(lcd_w//2+4, lcd_h//2, 80, 22, color=(0xff,112,0xff), fill=True)
116.     img = img.draw_string(lcd_w//2+4, lcd_h//2, "%.2f" %(center_temp), color=(0xff,0xff,0xff), scale=2)
117.     img = img.draw_cross(lcd_w//2, lcd_h//2, color=(0xff,0xff,0xff), thickness=3)
118.     if max_temp_pos:
119.         max_temp_pos = (int(lcd_w/sensor_width*max_temp_pos[0]), int(lcd_h/sensor_height*max_temp_pos[1]))
120.         img = img.draw_rectangle(max_temp_pos[0]+4, max_temp_pos[1], 80, 22, color=(0xff,112,0xff), fill=True)
121.         img = img.draw_string(max_temp_pos[0]+4, max_temp_pos[1], "%.2f" %(max_temp), color=(0xff,0xff,0xff),
122.                               scale=2)
123.         img = img.draw_cross(max_temp_pos[0], max_temp_pos[1], color=(0xff,0xff,0xff), thickness=3)
124.     fps =clock.fps()
125.     img = img.draw_string(2,2, ("%2.1ffps" %(fps)), color=(0xff,0xff,0xff), scale=2)
126.     lcd.display(img)
127.     img = com.read()
128.     del img
129.     gc.collect()
# gc.mem_free()
```

或者在 PC 使用 pyserial 上读取并显示:

```
1. import serial
2. import pygame
3. from pygame.locals import QUIT, KEYDOWN, K_f, K_F11, FULLSCREEN
4. from PIL import Image, ImageDraw
5. import matplotlib.pyplot as plt
```

```
6. import numpy as np
7. import time
8.
9. START_FLAG = 0x5A
10. width = 32
11. height = 24
12. dis_width = 320
13. dis_height = 240
14. auto_color = True
15. max_temp_limit = 300
16. min_temp_limit = -40
17.
18. com = serial.Serial()
19. com.baudrate = 460800
20. com.port = "/dev/ttyACM0"
21. com.bytesize = 8
22. com.stopbits = 1
23. com.parity = "N"
24. com.timeout = None
25. com.rts = True
26. com.dtr = True
27. com.open()
28.
29. pygame.init()
30. pygame.display.set_caption("pic from client")
31. screen = pygame.display.set_mode((dis_width, dis_height), 0, 32)
32.
33. def get_hot_color_map():
34.     hot_map = plt.get_cmap("hot")
35.     color_map = np.zeros((256,3), np.uint8)
36.     for i in range(256):
37.         color_map[i][0] = np.int_(hot_map(i)[0]*255.0)
```



```
38.     color_map[i][1] = np.int_(hot_map(i)[1]*255.0)
39.     color_map[i][2] = np.int_(hot_map(i)[2]*255.0)
40.     return color_map
41.
42. def temp_list2bytes(temperature_list):
43.     ret = b''
44.     for temp in temperature_list:
45.         ret += bytes([int(temp*10/2)])
46.     return ret
47.
48.
49. def get_dis_temp_by_target_temp(target_temp, in_size, out_size):
50.     # (in_w, in_h), (out_w, out_h)
51.     pass
52.
53. hot_color_map = get_hot_color_map()
54. color_array = np.zeros((height, width, 3), np.uint8)
55.
56. find_frame_flag = False
57. while 1:
58.     if not find_frame_flag:
59.         data = 0
60.         flag_count = 0
61.         while 1:
62.             data = com.read(1)
63.             if int.from_bytes(data, byteorder='little') == START_FLAG:
64.                 flag_count += 1
65.                 if flag_count == 2:
66.                     find_frame_flag = True
67.                     break
68.             else:
69.                 flag_count = 0
```

```
70.     else:
71.         find_frame_flag = False
72.         max_temp_pos=None
73.         data = com.read(2)
74.         data_len = int.from_bytes(data[:2], byteorder="little")
75.         sum = START_FLAG * 256 + START_FLAG + data_len
76.         if auto_color:
77.             min_temp = max_temp_limit
78.             max_temp = min_temp_limit
79.             data = com.read(data_len-2)
80.             target_temp = []
81.             for i in range(data_len//2-1):
82.                 v = int.from_bytes(data[i*2:i*2+2], byteorder='little')
83.                 sum += v
84.                 v /= 100.0
85.                 if auto_color:
86.                     if v < min_temp:
87.                         if v < min_temp_limit:
88.                             min_temp = min_temp_limit
89.                         else:
90.                             min_temp = v
91.                     if v > max_temp:
92.                         if v > max_temp_limit:
93.                             max_temp = max_temp_limit
94.                         else:
95.                             max_temp = v
96.                             max_temp_pos = (i%width, i//width)
97.             target_temp.append( v )
98.             data = com.read(2)
99.             v = int.from_bytes(data, byteorder='little')
100.            sum += v
101.            machine_temp = v/100.0
```



```
102.     data = com.read(2)
103.     parity_sum = int.from_bytes(data, byteorder='little')
104.     print("{:02x} {:02x}".format(parity_sum, sum%0xffff))
105.     # TODO: parity not correct according to the doc
106.     # if parity_sum != sum%0xffff:
107.     #     print("parity sum error")
108.     #     continue
109.     print("data length:", len(target_temp))
110.     print("machine temperature:", machine_temp)
111.     temp_bytes = temp_list2bytes(target_temp)
112.     if max_temp == min_temp:
113.         max_temp += 1
114.     # dis_temperature = get_dis_temp_by_target_temp(target_temp, (width, height), (dis_width, dis_height))
115.     try:
116.         for i in range(0, height):
117.             for j in range(0, width):
118.                 color = (target_temp[i*width+j]-min_temp)/(max_temp-min_temp)*255
119.                 color_array[i, j] = hot_color_map[int(color)]
120.             img = Image.fromarray(color_array)
121.             img = img.resize( (dis_width,dis_height), resample=Image.LANCZOS)
122.             draw = ImageDraw.Draw(img)
123.             draw.line((img.width/2-4, img.height/2, img.width/2+4, img.height/2), fill=0xff3ef8, width=1)
124.             draw.line((img.width/2, img.height/2-4, img.width/2, img.height/2+4), fill=0xff3ef8, width=1)
125.             draw.rectangle([(img.width/2+10, img.height/2), (img.width/2+40, img.height/2+10)], fill=0x10'
126.             center_temp = target_temp[int(width/2 + height/2*width)]
127.             draw.text((img.width/2+10, img.height/2), "{}".format(center_temp), fill=0xfffff)
128.             if max_temp_pos:
129.                 max_temp_pos = (int(dis_width/width*max_temp_pos[0]), int(dis_height/height*max_temp_pos[1]))
130.                 draw.line((max_temp_pos[0]-4, max_temp_pos[1], max_temp_pos[0]+4, max_temp_pos[1]), fill=0xff3ef8,
131.                           width=1)
132.                 draw.line((max_temp_pos[0], max_temp_pos[1]-4, max_temp_pos[0], max_temp_pos[1]+4), fill=0xff3ef8,
133.                           width=1)
```

```
132.         draw.rectangle([(max_temp_pos[0]+10, max_temp_pos[1]), (max_temp_pos[0]+40, max_temp_pos[1]+10)],  
133.             fill=0x10bd87)  
134.         draw.text((max_temp_pos[0]+10, max_temp_pos[1]), "{}".format(max_temp), fill=0xfffff)  
135.         surface = pygame.image.fromstring(img.tobytes(), img.size, img.mode).convert()  
136.         screen.blit(surface,(0, 0))  
137.         pygame.display.update()  
138.     except Exception as e:  
139.         print(e)  
140.  
141. com.close()
```

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主题

