

Installation Process:

Thermal Camera FLIR Vue Pro R:

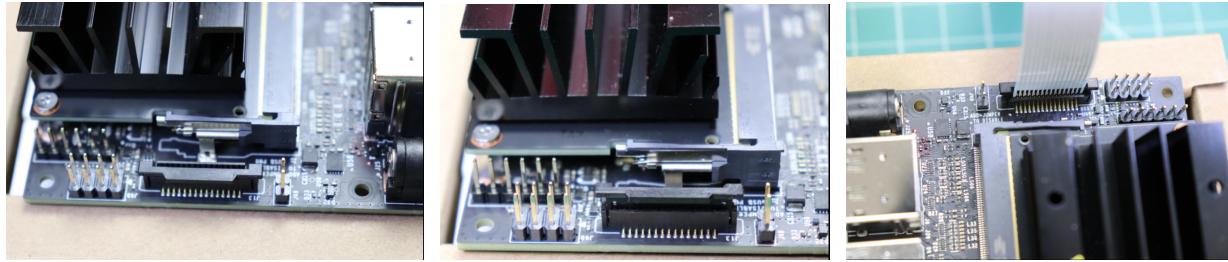
Items utilized for the Thermal Camera

- FLIR Vue Pro Camera with Camera Mount
- MicroSD Card
- Bench Cable
- Accessory Cable

For operation of the Thermal Camera, it will need a 4.8-6.0V power supply which will be given from the USB connection from the Jetson Nano using the Bench Cable this will also allow access from the Jetson Nano to the memory card of the thermal camera. It is important that you DO NOT exceed 6.0V for the input voltage, otherwise it will damage the camera! We will be using PWM3 and PWM4 of the Accessory cable for the operation of the viewing modes as well as a way to record information for manipulation through Pulse-Width-Modulation (PWM) from the Jetson Nano pins. PWM3 and PWM4 will have two wires each, one for ground and the other is for the PWM signal. Respectively, they will be attached to ground pins of the Jetson Nano and then the signals for PWM3 and PWM4 will be connected to pins 32 and 33. This will require the user to reconfigure the pins on the Jetson Nano, see “Reconfiguring the Jetson Nano GPIO Pins” in Configuration of the User Manual for further instructions. In our system, PWM3 is for the purpose of changing the different viewing modes, while PWM4 is meant to stop/start recording of the thermal camera.

HD Camera:

The installation of the Raspberry Pi camera requires that python 3 Open Source Computer Vision Library (openCV) software is installed on the Nvidia Jetson Nano. Our system operates with openCV2 version 4.1.1. We recommend that this version be installed. We have imported the OpenCV2 library on the python script that captures an image using the HD camera and must be made available to operate the camera. Then, the Raspberry Pi camera must be interfaced with the CSI port of the Nvidia Jetson Nano as shown in figure 4. Begin by first opening the CSI port camera connector as shown in Figure 4b and then place the cable of the raspberry pi camera with the contacts facing towards the Jetson Nano as shown in Figure 4c.



a. Camera connector closed b. Camera Connector open c. Camera connected with Pi
 Figure 4. The Raspberry Pi camera interfaced with the CSI port of the Nvidia Jetson Nano

The Raspberry Pi camera is now installed and ready for operation.

Configuration and Use Process:

Thermal Camera:

In our system, PWM3 is for the purpose of changing the different viewing modes, while PWM4 is meant to stop/start recording of the thermal camera.

Setting Up the PWM Functions of the Thermal Camera

1. Download the FLIR Vue Pro Application on a phone. Enable Bluetooth on your phone.
2. Open the App and connect with the camera. On the home screen, click on the settings and go to the Accessory Port Tab and enable both PWM3 and PWM4. For our system, PWM3 will have three states for the color viewing modes (whitehot, greenhot, and fusion) and 2 states for PWM4 (stop and start recording).
3. Now the thermal camera is set up for use.

Reconfiguring the Jetson Nano GPIO Pins

1. Open up a terminal on the Jetson Nano. Expand the window of the terminal for easier use.
2. Enter the following command in the terminal:
`$ sudo /opt/nvidia/jetson-io/jetson-io.py`
3. Once entered, this screen will display in the terminal.

```
===== Jetson Expansion Header Tool =====

      3.3V ( 1) ( 2) 5V
      i2c2 ( 3) ( 4) 5V
      i2c2 ( 5) ( 6) GND
      unused ( 7) ( 8) uartb
      GND ( 9) (10) uartb
      unused (11) (12) unused
      unused (13) (14) GND
      unused (15) (16) unused
      3.3V (17) (18) unused
      unused (19) (20) GND
      unused (21) (22) unused
      unused (23) (24) unused
      GND (25) (26) unused
      i2c1 (27) (28) i2c1
      unused (29) (30) GND
      unused (31) (32) unused
      unused (33) (34) GND
      unused (35) (36) unused
      unused (37) (38) unused
      GND (39) (40) unused

Select one of the following options:
Configure Jetson for compatible hardware
Configure 40-pin expansion header
Exit[]
```

Figure 5. Jetson Expansion Header Tool Screen

4. Using the Arrow Keys on the keyboard move to “Configure 40-pin expansion header” and press enter.
5. A new screen will display as shown below. Once again with the keyboard, move to “pwm0” and press enter to enable PWM output for the Jetson Nano. Do the same for “pwm2”. Then move to “Back” and press enter.

```
===== Jetson Expansion Header Tool =====

Select desired functions (for pins):
[ ] aud_mclk      (7)
[ ] i2s4          (12,35,38,40)
[ ] pwm0          (32)
[ ] pwm2          (33)
[ ] spi1          (19,21,23,24,26)
[ ] spi2          (13,16,18,22,37)
[ ] uartb-cts/rts (11,36)

Back[]
```

Figure 6. Jetson Expansion Header Tool Screen

6. Now it will return you to a similar screen from Step 3. Now you will want to move to “Save and reboot to reconfiguring pins”. The system will then begin a reboot.



Figure 7. Jetson Expansion Header Tool Screen Updated

- Now your Jetson Nano will be able to produce PWM outputs on pins 32 and 33.

Maintenance Process:

Thermal Camera:

For the thermal camera, the operational temperature should be between -4°F to 122°F. The rated altitude for the camera is tested by the company and should not exceed 40,000 ft. If the software or firmware receive any updates or fixes please refer to the instructions below on how to update the device.

Software/Firmware Update

Application Update

- Any update for the app can be found on the respective app store.

Firmware Update

- The latest firmware for the camera will be found here:
<http://www.flir.com/suas/vuepro/software/>
- Backup the camera settings. Only make note of the settings you enabled. With the update the settings will reset to default settings.
- Download the firmware update to a computer with internet access with the camera connected through the Bench Cable and save the firmware to the microSD memory.
- You will then need to power the camera for interaction through the app.
- Now in the app, you will begin the update process with the new firmware. This will enable another re-boot.
- You will now reset the device to its factory defaults. This can be done in the advance tab, then the About tab, and should have an option to reset to factory defaults.
- All the firmware should be updated and can be checked through the settings. From step 2 revert any settings you had before the update to the newly updated device. For more

information, please refer to the user manual of the FLIR Vue Pro:
<https://www.flir.com/products/vue-pro-r/>

HD Camera:

The maintenance of the Raspberry Pi camera requires that the camera not be susceptible to the heat radiating off of the vent of the Nvidia Jetson Nano. Close proximity to heat may compromise the camera's functionality. After interfacing the camera with the Nvidia Jetson Nano, do not attempt to break this connection while the microcomputer is powered on. Doing so may adversely affect the camera and eventually comprise its functionality. Also, we recommend that OpenCV2 version 4.1.1 be installed in python 3 to operate the camera. If an update is available, please determine first if this new version is compatible with the Raspberry Pi camera Module 2 before installing.

Troubleshooting Operation

Thermal Camera:

If the camera is not changing viewing modes:

Ensure that the PWM3 wires are hooked up to their corresponding pin numbers on the Jetson Nano, in this case pin 32 and GND.

If the camera is not recording:

Ensure that the PWM4 wires are hooked up to their corresponding pin numbers on the Jetson Nano in this case pin 33 and GND.

HD Camera:

If the system cannot find the HD camera:

Make sure that the camera is in fact properly interfaced with the CSI port of the Nvidia Jetson Nano. Refer to the installation section of the User Manual for reference on how to do this properly (section 6b).