GoPiGo3 Getting Started with Bullseye

Contents

GoPiGo3 Install Raspberry Pi OS Bullseye

Raspberry Pi OS is Linux: All commands are **case sensitive.**

NOTE: Remove all USB drives from computer except the MicroSD adapter.

1. Insert a MicroSD adapter with a minimum 8 GB MicroSD card into a USB port on your computer.
2. Download and install **Raspberry Pi Imager:** https://www.raspberrypi.com/software
3. Start Raspberry Pi Imager.
4. Choose Device: **Raspberry Pi3.**
5. Choose OS → **Raspberry Pi OS (Legacy, 32-bit)**
6. Click **CHOOSE STORAGE → TS-RDF5 SD Transcend** (or whatever device has the MicroSD card)
7. Click Next.
8. Would you like to apply OS customization settings?
9. **Edit Settings**.
    a. Set hostname
    b. Set username and password: pi Password01
    NOTE: Please do not change the username.
    c. Configure wireless LAN
    d. Set locale settings
    e. Go to Services: Enable SSH → Use password authentication
    f. Click **Save**.

g. Click **Yes**.

10. All existing data will be erased. Click **Yes**.

11. When prompted: Remove the MicroSD adapter.

Boot and Connect to the GoPiGo3

1. Power off the GoPiGo3.

2. Plug in the external Wi-Fi adapter.

3. Insert the MicroSD card in the Raspberry Pi. (You will probably need a tweezers or something similar.)

4. Power up the GoPiGo3. This will take a little longer the first time you boot the robot.

The GoPiGo3 should connect to your wireless network.

There are a couple of ways to find the GoPiGo3's IP address. Note the IP address, you will need it to connect with SSH.

Network Scanner Method

- Advanced IP Scanner - https://www.advanced-ip-scanner.com

- Use ZenMap with Quick Scan setting www.nmap.org

Your GoPiGo3 should show up on your network scan with an IP address.

Plug in an Ethernet Cable

If your wireless does not connect, you may have to plug in an Ethernet cable to the GoPiGo3. Rescan.

Last Resort: Keyboard, Mouse, Monitor

Connect a keyboard, mouse and monitor to the GoPiGo3. Connect to or point to the wireless or wired connection. You want the IP address.

Connect by SSH and Configure the Pi with raspi-config

You finally have the IP address. Yeah!

Windows SSH

Windows does not have a built-in SSH client.

1. Go to https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
2. Download the **PuTTY** client.
3. Start the **PuTTY** client. Type in the **IP address** of the GiPiGo3 → Click **Open**.
4. **Accept** the **PuTTY Security Alert**.
5. Login as the username and password that you set.

MAC or Linux SSH

Mac and Linux have a built-in SSH client.

1. Open a terminal prompt
2. **ssh pi@ipaddress** (Where ip address is the ip address of the Pi.)
3. Login with the password that you set.

Configure the Pi with raspi-config

raspi-config is a terminal based program for configuring the Raspberry pi. We want to turn on VNC for remote GUI access, and turn on SPI and I2C for sensor access.

1. At the ssh terminal prompt type: **sudo raspi-config**
    a. **Interface Options** → **VNC** → Select **Yes.**
    b. **Interface Options** → **SPI** → Select **Yes.**
    c. **Interface Options** → **I2C** → Select **Yes.**
2. Exit the **raspi-config** interface.

Update Raspberry Pi OS

Reconnect with ssh. Run the following commands to update the Pi OS.

```
# Update the apt package list
sudo apt update
# Upgrade all packages -y no prompt
sudo apt full-upgrade -y
# Remove any packages that are not needed, there may not be any
sudo apt autoremove
# It is a good idea to reboot after an update
sudo reboot
```

Disable Onboard Wi-Fi

The internal Pi antenna works just fine. For better signal strength and range you may want to use an external USB Wi-Fi antenna.

To use an external Wi-Fi antenna only, disable the internal Wi-Fi.

1. Reconnect using PuTTY.

```
# Edit this file with nano
sudo nano /boot/config.txt
# Add this line to the end of the file and save it
dtoverlay=disable-wifi
```

2. Restart the Pi.

```
sudo reboot
```

NOTE: After you have disabled the on-board Wi-Fi, you must always plug a Wi-Fi adapter into a USB port.

Turn Off Wi-Fi Power Saving

If your Pi experiences WiFi connection issues, turn off the power saving.

```
# Turn off wifi power saving
# Show the connection name
sudo nmcli connection show
sudo nmcli connection modify <connection name> 802-11-wireless.powersave 2
sudo nmcli connection show <connection name>
```

Modify connection name.

```
sudo nmcli connection modify <connection-name> connection.id <new-connection-name>
```

Multiple SSID’s

Edit the following file if you wish to setup more than one wifi SSID. If there is more than SSID in range, priority=5 sets ‘YourSSID’ over priority=4 for ‘YourOtherSSID’ If they are not in range of each other, make them both 1.

Use the following command to edit the wpa_supplicant.conf file.

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```

The following shows an example of how you might configure another SSID.

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
country=US

network={
   ssid="YourSSID"
   psk="YourPSK"
   priority=1
}
network={
   ssid="YourOtherSSID"
   psk="YourOtherPSK"
   priority=1
}
```

1. **CTRL+S** (Saves the file)
2. **CTRL+X** (Exit nano)

The pi will automatically connect to whichever wireless network is closer and has better signal. You can add as many wireless networks to this file as you wish.

Setup GoPiG3 Software

Connect to the GoPiGo3 with ssh. At the terminal, type the following commands without sudo. The libraries will install properly only if installed as the pi user.

You can copy and paste the commands into ssh. Use Shift Insert to paste into ssh.

1. Run the following commands to download the setup and test scripts.

```
wget https://raw.githubusercontent.com/itinstructor/GoPiGo3/main/setup_gopigo3_on_32-bit_Bullseye.sh
wget https://raw.githubusercontent.com/slowrunner/GoPiGo3-Bullseye_32-bit/main/test_read_info.sh
```

2. Run the setup script.

```
bash setup_gopigo3_on_32-bit_Bullseye.sh
```

3. Installing the GoPiG3 software will take some time.
4. Shutdown the Raspberry Pi with shutdown with poweroff to make the settings take effect.

```
poweroff
```

5. Power up the GoPIGo3. Run the following test script.

```
bash test_read_info.sh
```

Configure VNC Display Settings

Connect to the pi with ssh.

Uncomment and modify the following:

```
# Edit the config.txt file
sudo nano /boot/config.txt

hdmi_force_hotplug=1
hdmi_group=2
hdmi_mode=23 # 1280x768
hemi_mode=35 # 1280x1024
```

RealVNC Viewer

RealVNC viewer allows us to remotely control the GoPiGo3 in headless mode.

NOTE: RealVNC does not consistently copy and paste code. It does refresh the screen faster than TigerVNC.

1. Go to https://www.realvnc.com/en/connect/download/viewer/
2. Download the VNC Viewer Standalone EXE anywhere you want to run the program. You don’t have to install it.
3. Double Click **VNC Viewer**.
4. Type in the IP address of your robot → Click **Connect**.

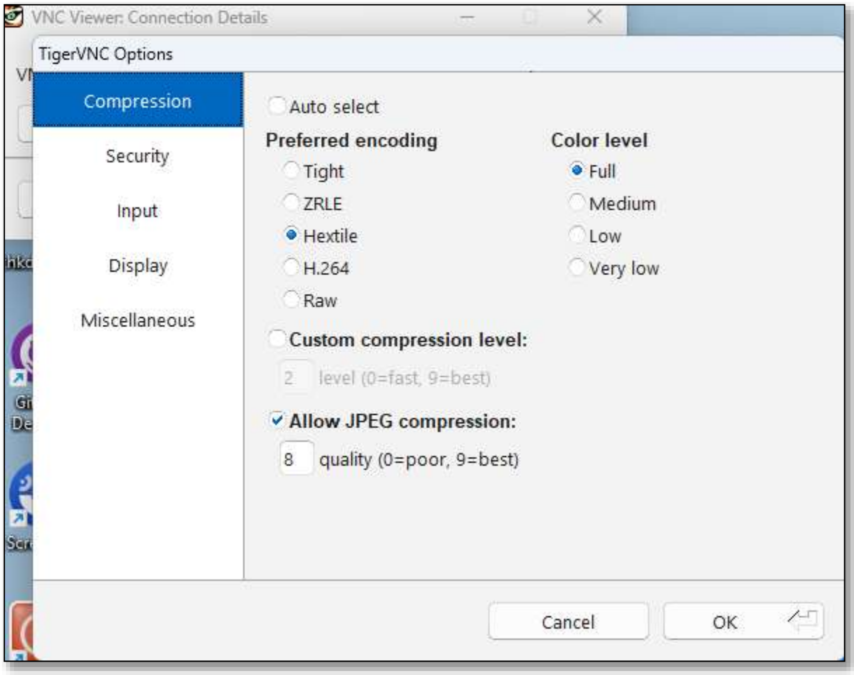
TigerVNC Viewer

You can remote control the GoPiGo3 in headless mode.

NOTE: TigerVNC will consistently copy and paste code. It does not refresh the screen as well as RealVNC.

1. https://sourceforge.net/projects/tigervnc/
2. Download the latest vncviewer64 exe.
3. This is a self executing program, it does not need an installation.
4. Double Click the downloaded file.
5. Type in the IP address of your robot → Click **Connect**.
6. If the desktop is not displayed, you may need to connect with PuTTY. Use **sudo reboot** to restart the Pi.

NOTE: You may have to go to Options and change the encoding to Hextile.



○ Auto select

Preferred encoding

○ Tight
○ ZRLE
● Hextile
○ H.264
○ Raw

Color level

● Full
○ Medium
○ Low
○ Very low

○ Custom compression level:

2 level (0=fast, 9=best)

☑ Allow JPEG compression:

8 quality (0=poor, 9=best)

Setting up a Gmail Account for Email

NOTE: This directions may not work any more. You may have to Google how to setup SMTP for a 3rd party application.

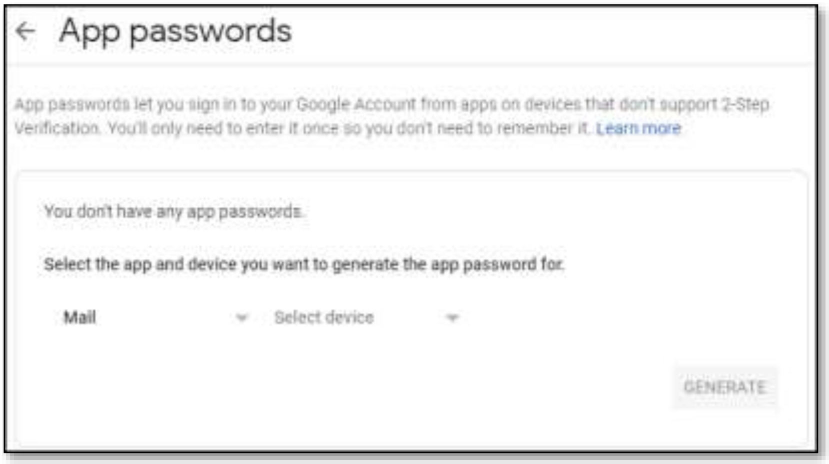
If you don’t have a Gmail account, you will want to create one.

Let’s enable your Gmail account to receive connections from external programs, like Python.

1. Open your browser and access your Gmail account.
2. On the login screen → enter your Gmail username and password.
3. After the login → access the following URL:
   https://myaccount.google.com/signinoptions/two-step-verification
4. Enable the two-step verification on this account.

Create an Application Password

1. Access the following URL:
   https://security.google.com/settings/security/apppasswords
2. Select Gmail application and the type of device: **Other**.



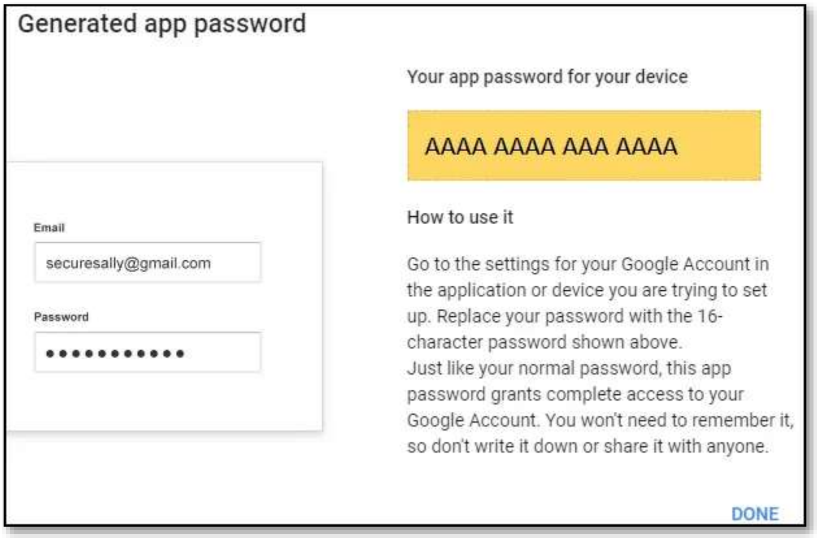
App passwords

App passwords let you sign in to your Google Account from apps on devices that don't support 2-Step Verification. You'll only need to enter it once so you don't need to remember it. Learn more

You don't have any app passwords.

Select the app and device you want to generate the app password for.

3. Name the device: **Python**
4. Click on the Generate button and take note of the randomly generated password.



Generated app password

Email
securesally@gmail.com

Password
●●●●●●●●●●●●

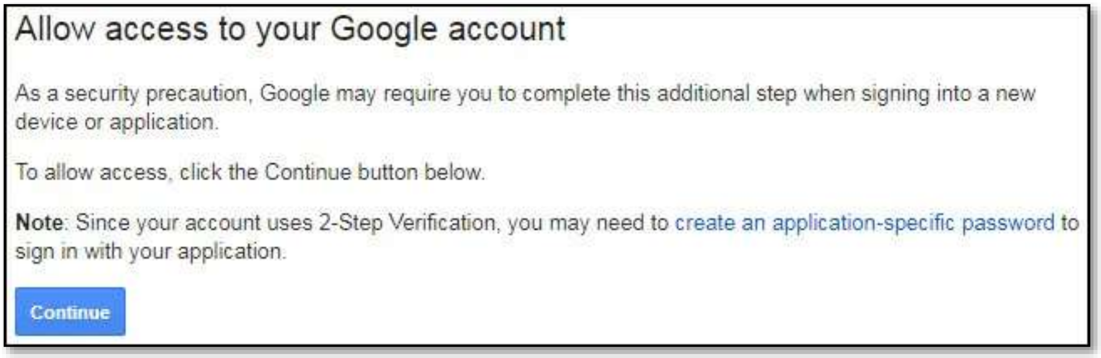
Your app password for your device

AAAA AAAA AAA AAAA

How to use it

Go to the settings for your Google Account in the application or device you are trying to set up. Replace your password with the 16-character password shown above.
Just like your normal password, this app password grants complete access to your Google Account. You won't need to remember it, so don't write it down or share it with anyone.

5. Access the following URL:
6. https://accounts.google.com/DisplayUnlockCaptcha
7. Click on the **Continue** button to enable external access to your Google account.



Allow access to your Google account

As a security precaution, Google may require you to complete this additional step when signing into a new device or application.

To allow access, click the Continue button below.

Note: Since your account uses 2-Step Verification, you may need to create an application-specific password to sign in with your application.

You have finished the required steps for the Gmail integration.

Email IP Address on Startup

We want our GoPiGo3 to email us it's IP address on startup.

Complete the following steps from a terminal.

1. Create a folder to store your Python programs.

```
mkdir /home/pi/Code/
cd /home/pi/Code/
# Use the following command to download startup_mailer.py
wget https://raw.githubusercontent.com/itinstructor/GoPiGo3/main/Raspberry%20Pi/startup_mailer.py
```

2. Edit startup_mailer.py → **nano startup_mailer.py**

3. Change the **EMAIL_DEST** email address to your own email address.

4. Change **EMAIL_FROM** and **APP_PASSWORD** to your Gmail account that you setup to send email through.

5. Save the file.

6. Type in the following command to make the script executable.

```
sudo chmod 755 /home/pi/Code/startup_mailer.py
```

7. There should not be any errors if the command was successful.

8. Test the script with the following command.

```
/home/pi/Code/startup_mailer.py
```

9. In a few moments, you should receive an email with your GoPiGo3 IP address.

Run startup_mailer.py Script on Startup

1. At the terminal, type in the following command to access the Raspbian scheduler. (Don't add sudo)

```
crontab -e
```

2. Press **Enter** to edit the file with nano.

3. Cursor to the bottom of the file. (The mouse will not work.)

4. Enter or copy and paste the following information. (sleep 15 waits 15 seconds after startup to run the script.)

```
@reboot sleep 15 && /home/pi/Code/startup_mailer.py
```

5. Type **CTRL+S** to Save the file.

6. Press **CTRL+X** to Exit nano.

7. Reboot the pi: **sudo reboot**

8. You should receive an email with your IP address.

Configure Raspberry Pi OS (Optional)

1. Right Click Desktop → **Desktop Preferences** → **Layout**: No image

    a. Colour: Choose a colour you like.

2. **Change Clock Display:** Right Click Clock, Digital Clock Settings
    a. To show seconds, **%r**
    b. To show minutes: **%I:%M %p**
3. **Add Temperature Monitor:** Right Click Task Bar → Panel Settings → Panel Applets tab.
    a. **Add** → **Temperature Monitor** → **Add**.
    b. Click **Up** to move the Temperature Monitor to the left on the taskbar.
    c. Click **Preferences**.
        i. **Normal color**: **#00008b** (Dark blue)
        ii. **Warning1 temperature**: 60
        iii. **Warning2 temperature**: 80

Set Desktop Shortcuts to Open Without Prompt

In **File Manager** → **Edit** → **Preferences** → Check **Don’t ask options on launch executable file**

Hardware Information

```
# The top command will show memory, cpu, processes, etc
top
# This one has colors and is prettier
htop
# Quit
q
```

```
cat /proc/cpuinfo
# Display the current CPU temperature
vcgencmd measure_temp
```

```
# Displays detailed information about the hardware
sudo apt update
sudo apt install lshw
sudo lshw
sudo lshw -short
```

Wi-Fi Signal Strength wavemon

The **iwconfig** command will give you a snapshot of Wi-Fi quality.

wavemon will monitor Wi-Fi signal strength in real time.

```
# Install wavemon
sudo apt install wavemon -y
# Run wavemon
wavemon
# Quit wavemon
q
```

Signal Strength

The higher the signal strength, the more reliable the connection and higher speeds are possible. The signal strength is specified as -dBm (decibels related to one milliwatt).

Values between 0 and -100 are possible, with more being better. -51 dBm is a better signal strength than -60 dBm.

The value 0 is not realistic. Even -30 dBm is hard to reach, and you have to stand almost directly next to the access point.

Some guidance on how to read the results:

- 50 dBm is considered an excellent signal strength.
- 67 dBm is said to be the minimum signal strength for reliable and relatively fast packet delivery.
- 70 dBm is the minimum signal strength for reliable packet delivery.
- The minimum value for a basic connection is -80 dBm. However, packet delivery is no longer necessarily reliable.
- 90 dBm is already very close to the basic noise. Here a connection probably does not work anymore.

Link Quality

A network can have very good signal strength without good link quality.

This is how much of the data you send and receive will make it to the destination in good condition.

The quality indicator includes data like Bit Error Rate (BER), i.e., the number of bit errors in received bits that have been altered due to noise, interference, distortion, or bit synchronization errors. Others are Signal-to-Noise and Distortion Ratio (SINAD).

It is measured in percentage or on a scale of up to 70. So you will see a value like “60/70”.

Unlike signal strength, it is somewhat harder to say which values are still considered to be ok.

If the value is low and your signal strength is high, you may have interference from, e.g., kitchen appliances or other electronic devices. Moving them further away may improve the link quality.

Frequency

Another interesting indicator is the Wi-Fi frequency.

This shows if your Raspberry Pi connects to the slower and longer range 2.4 GHz network, or the faster but shorter range 5 GHz version, provided, of course, that your router offers both networks.

Speedtest

Install speedtest-cli from Speedtest.net

```
sudo apt update
sudo apt dist-upgrade -y

# Install support software
sudo apt install apt-transport-https gnupg1 dirmngr lsb-release

# Install keychain to download speed-cli
curl -L https://packagecloud.io/ookla/speedtest-cli/gpgkey | gpg --dearmor |
sudo tee /usr/share/keyrings/speedtestcli-archive-keyring.gpg >/dev/null

sudo apt update

sudo apt install speedtest-cli

speedtest
```

Find Ports with ls dev/tty

Pi serial port is ttyAMA0

```
sudo ls /dev/tty*
```

This will list all of the terminal interfaces.

16 Tick Motors

Some GoPiGo3 motors operate on 16 ticks rather than 6 ticks. You can tell because the wheels go very slowly.

1. Edit the gpg3_config.json as shown.

```
nano /home/pi/Dexter/gpg3_config.json
```

2. Change ticks to 16 as shown below

```
{"wheel-diameter": 66.5, "wheel-base-width": 117, "ticks": 16, "motor_gear_ratio": 120}
```

3. Reboot the Raspberry Pi to make the settings take effect: **sudo reboot**

Visual Studio Code (Optional)

Visual Studio Code is available on the Raspberry Pi. It will be automatically updated when the system OS is upgraded.

```
sudo apt update
sudo apt dist-upgrade -y
sudo apt install code
```