

Peer-to-Peer connection Raspberry Pi & Flutter App

This guide explains how to configure a Raspberry Pi to act as a Wi-Fi Direct (P2P) Group Owner, allowing direct peer-to-peer communication with a mobile device running the robot control app.

Setup on the Raspberry Pi

This process involves configuring `wpa_supplicant` for Wi-Fi Direct mode and `dnsmasq` for IP assignment.

Step 1: Install Necessary Packages

Ensure `wpa_supplicant` and `dnsmasq` are installed.

```
sudo apt update
sudo apt install -y wpa_supplicant dnsmasq
```

Step 2: Configure Wi-Fi Direct (P2P) Settings in `wpa_supplicant`

This file defines how your Raspberry Pi will behave as a P2P device and Group Owner.

1. Create/Edit the P2P configuration file:

```
sudo nano /etc/wpa_supplicant/p2p.conf
```

2. Add the following content:

```
ctrl_interface=/var/run/wpa_supplicant
update_config=1
device_name=RobotP2PDevice
device_type=1-0050F204-1
driver_param=use_p2p_group_interface=1
p2p_group_ssid=RobotP2P          # set your ssid
p2p_group_passphrase=robot1234  # set your password
```

- **p2p_group_ssid=RobotP2P:** This is the Wi-Fi network name your phone will see.
- **p2p_group_passphrase=robot1234:** This is your Wi-Fi password for the P2P network. Choose a strong, unique password.

- **device_name:** You can change RobotP2PDevice to something more descriptive.

3. Save the file.

Step 3: Configure Network Interface for P2P

We need to tell the system to bring up wlan0 and let wpa_supplicant manage it.

1. Edit /etc/network/interfaces:

```
sudo nano /etc/network/interfaces
```

2. Add/Modify for wlan0:

Ensure the wlan0 section looks like this:

```
auto wlan0
iface wlan0 inet manual
    wpa-driver nl80211 # or wext if nl80211 is not supported by your hardware/driver
    wpa-conf /etc/wpa_supplicant/p2p.conf
```

- inet manual is important, as wpa_supplicant will handle the IP assignment for the P2P group.
- wpa-driver nl80211 is standard.

3. Save the file.

Step 4: Configure dnsmasq for the P2P Interface IP

dnsmasq will provide IP addresses to devices connecting to the P2P network.

1. Edit dnsmasq.conf:

```
sudo nano /etc/dnsmasq.conf
```

2. Add the following lines:

```
interface=p2p-wlan0-0 # This is the interface created by wpa_supplicant for P2P
listen-address=192.168.49.1 # The IP address of your Pi on the P2P network
bind-interfaces
# DNS servers for resolving hostnames outside the local network (if P2P network has internet access)
server=8.8.8.8
server=8.8.4.4
domain-needed
bogus-priv
# DHCP range for devices connecting to the P2P network
dhcp-range=192.168.49.2,192.168.49.20,255.255.255.0,24h
```

- **interface=p2p-wlan0-0:** This is crucial. It tells dnsmasq to serve the P2P interface.
- **listen-address=192.168.49.1:** This is the IP address the Pi will have on the P2P network.

3. Save the file.

Step 5: Ensure Hostapd and other conflicting services are disabled

Make sure only wpa_supplicant is managing the Wi-Fi interface for P2P.

```
sudo systemctl stop hostapd.service
sudo systemctl disable hostapd.service
sudo systemctl stop dnsmasq.service
sudo systemctl disable dnsmasq.service # Temporarily disable it as we'll manage manually
sudo systemctl stop wpa_supplicant.service # Ensure it's not running from a previous state
sudo systemctl disable wpa_supplicant.service
sudo systemctl daemon-reload
```

Step 6: Manually Start and Test the P2P Process

This is the step-by-step validation.

1. Start wpa_supplicant for P2P:

```
sudo wpa_supplicant -B -iwlan0 -Dnl80211 -c/etc/wpa_supplicant/p2p.conf
```

- Watch for "Successfully initialized wpa_supplicant".
- If see errors about the configuration file, re-check /etc/wpa_supplicant/p2p.conf for syntax errors.

- If see Failed to initialize control interface, try `sudo rm -f /var/run/wpa_supplicant/wlan0` and then rerun the `wpa_supplicant` command.

2. Wait a moment for wpa_supplicant to initialize.

3. Create the P2P Group:

```
sudo wpa_cli -iwlan0 p2p_group_add
```

- This should return **OK** if `wpa_supplicant` is running.
- If it fails to connect, `wpa_supplicant` might not have started correctly, or its control interface is inaccessible.

4. Check Interface Status:

```
ifconfig
```

You should see `p2p-wlan0-0` listed with an IP address (likely 192.168.49.1).

```
limon@raspberrypi:~ $ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.231 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::a540:951f:7e5c:e5b5 prefixlen 64 scopeid 0x20<link>
    ether 88:a2:9e:06:de:a5 txqueuelen 1000 (Ethernet)
    RX packets 55736 bytes 5204067 (4.9 MiB)
    RX errors 0 dropped 207 overruns 0 frame 0
    TX packets 77877 bytes 132067243 (125.9 MiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
    device interrupt 107

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 30 bytes 3721 (3.6 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 30 bytes 3721 (3.6 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

p2p-wlan0-0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.49.1 netmask 255.255.255.0 broadcast 0.0.0.0
    inet6 fe80::88a2:9eff:fe06:5ea6 prefixlen 64 scopeid 0x20<link>
    ether 8a:a2:9e:06:5e:a6 txqueuelen 1000 (Ethernet)
    RX packets 583356 bytes 31335677 (29.8 MiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4820580 bytes 6874930647 (6.4 GiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    ether 88:a2:9e:06:de:a6 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

If there is NO ip showing on p2p-wlan0-0 then run below command and do again ifconfig

```
sudo ip addr add 192.168.49.1/24 dev p2p-wlan0-0
```

5. Start dnsmasq:

```
sudo systemctl start dnsmasq.service
```

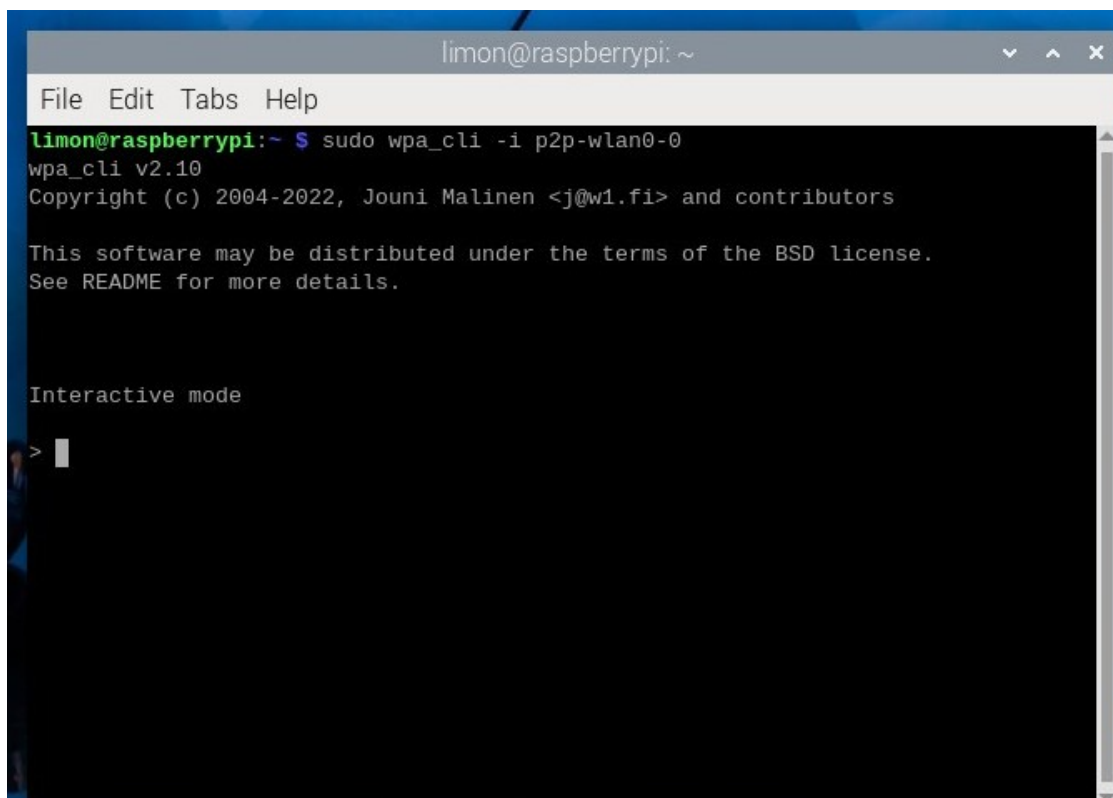
- Check its status: `sudo systemctl status dnsmasq.service`. It should now be active (running).

WIFI-CONNECTIVITY:

One of the **major** problem is the SSID and PASSWORD can't be set manually. Every reboot it generate random ssid and password. So below is the process to get ssid and password

On terminal

```
sudo wpa_cli -i p2p-wlan0-0
```

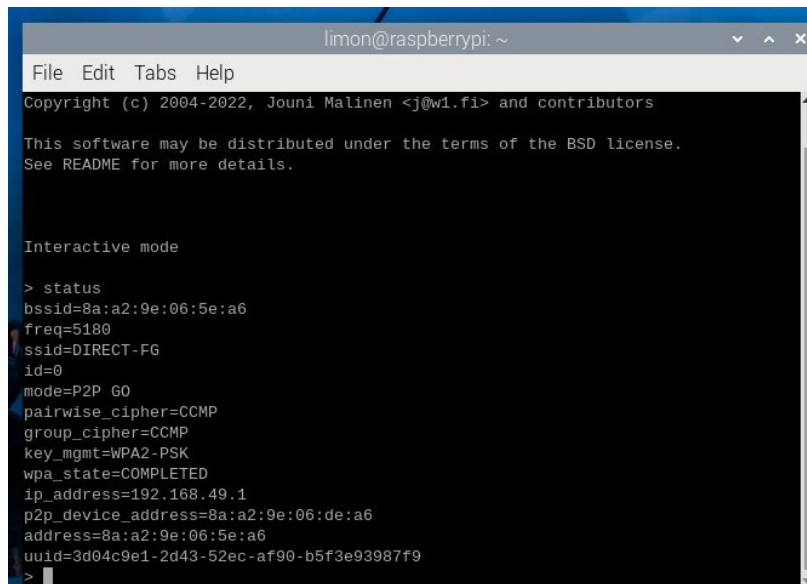
A screenshot of a terminal window titled 'limon@raspberrypi: ~'. The terminal shows the command 'sudo wpa_cli -i p2p-wlan0-0' being executed. The output of the command is displayed, including the version 'wpa_cli v2.10', copyright information for Jouni Malinen, and a notice about the BSD license. The terminal then enters 'Interactive mode' and shows a prompt '>' with a cursor.

```
limon@raspberrypi: ~  
File Edit Tabs Help  
limon@raspberrypi:~ $ sudo wpa_cli -i p2p-wlan0-0  
wpa_cli v2.10  
Copyright (c) 2004-2022, Jouni Malinen <j@w1.fi> and contributors  
  
This software may be distributed under the terms of the BSD license.  
See README for more details.  
  
Interactive mode  
> |
```

Then type

status

- Can find the SSID

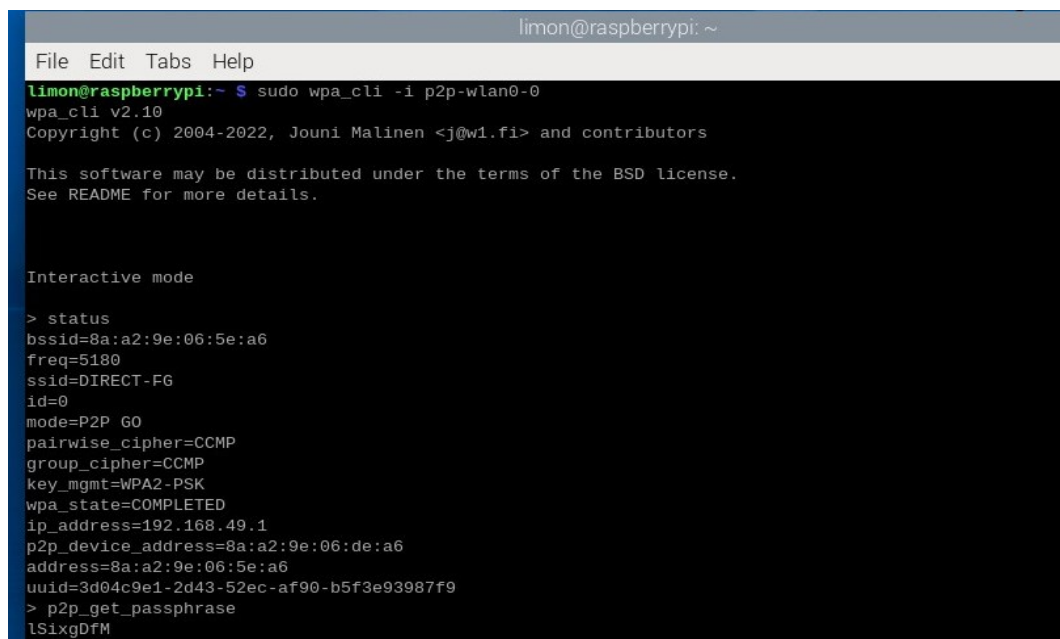


```
limon@raspberrypi: ~  
File Edit Tabs Help  
Copyright (c) 2004-2022, Jouni Malinen <j@w1.fi> and contributors  
  
This software may be distributed under the terms of the BSD license.  
See README for more details.  
  
Interactive mode  
  
> status  
bssid=8a:a2:9e:06:5e:a6  
freq=5180  
ssid=DIRECT-FG  
id=0  
mode=P2P GO  
pairwise_cipher=CCMP  
group_cipher=CCMP  
key_mgmt=WPA2-PSK  
wpa_state=COMPLETED  
ip_address=192.168.49.1  
p2p_device_address=8a:a2:9e:06:de:a6  
address=8a:a2:9e:06:5e:a6  
uuid=3d04c9e1-2d43-52ec-af90-b5f3e93987f9  
>
```

type

p2p_get_passphrase

- It will show the passphrase/password



```
limon@raspberrypi: ~  
File Edit Tabs Help  
limon@raspberrypi:~$ sudo wpa_cli -i p2p-wlan0-0  
wpa_cli v2.10  
Copyright (c) 2004-2022, Jouni Malinen <j@w1.fi> and contributors  
  
This software may be distributed under the terms of the BSD license.  
See README for more details.  
  
Interactive mode  
  
> status  
bssid=8a:a2:9e:06:5e:a6  
freq=5180  
ssid=DIRECT-FG  
id=0  
mode=P2P GO  
pairwise_cipher=CCMP  
group_cipher=CCMP  
key_mgmt=WPA2-PSK  
wpa_state=COMPLETED  
ip_address=192.168.49.1  
p2p_device_address=8a:a2:9e:06:de:a6  
address=8a:a2:9e:06:5e:a6  
uuid=3d04c9e1-2d43-52ec-af90-b5f3e93987f9  
> p2p_get_passphrase  
lSixgDrM
```

1. Search the mobile wifi you can find the wifi name “DIRECT-FG” (The name will be random according to your device)
2. Click and provide the password you get as passphrase above.

Common Problems and Possible Solutions:

- **After reboot wifi-direct gone**

- **Cause:** This is another major problem. After reboot it needs to setup again. Still can't working much on it. So can't surely say where is the problem.
- **Solution:** Can do all the process below for start the server

Ensure hostapd and dhcpcd are disabled/stopped for this P2P setup:

```
sudo systemctl stop hostapd.service
sudo systemctl disable hostapd.service
sudo systemctl stop dhcpcd.service
sudo systemctl disable dhcpcd.service
```

1.

Now, the commands to start the P2P services and your server:

1. **Start wpa_supplicant for P2P:**

This command initializes wpa_supplicant and tells it to manage the P2P interface.

```
sudo wpa_supplicant -B -iwlan0 -Dnl80211 -c/etc/wpa_supplicant/p2p.conf
```

- **Wait for wpa_supplicant to initialize:**

Give it a few seconds to get ready.

```
sleep 5
```

- **Create the P2P Group:**

This command tells wpa_supplicant to form the Wi-Fi Direct group.

```
sudo wpa_cli -iwlan0 p2p_group_add
```

- You should see OK if successful.
- **Verify the P2P Interface and IP:**
Check that the p2p-wlan0-0 interface is up and has an IP address.

```
ifconfig
```

- You should see p2p-wlan0-0 with an IP like 192.168.49.1.
- **Start dnsmasq:**
Now that the P2P interface is up and has an IP, start dnsmasq so it can assign IPs to connecting devices.

```
sudo ip addr add 192.168.49.1/24 dev p2p-wlan0-0  
sudo systemctl start dnsmasq.service
```

- **Check dnsmasq status:**

```
sudo systemctl status dnsmasq.service
```

- It should show active (running).
- **Start your C++ Server:**
Navigate to your server's build directory and run your executable.

```
cd /path to server code/build  
./selector_test
```

•

- **SSID Not Visible:**
 - **Cause:** hostapd not running, incorrect hostapd.conf (e.g., country_code missing/wrong, ignore_broadcast_ssid=1, syntax errors).
 - **Solution:** Ensure hostapd is running, country_code is set, and check hostapd.conf for syntax errors. **BUT**, since using P2P, you should be using wpa_supplicant for this, not hostapd. The P2P SSID should be set in p2p.conf or via wpa_cli.
- **wpa_supplicant Fails to Initialize (Control Interface Error):**
 - **Cause:** Incorrect p2p.conf syntax for your wpa_supplicant version, or stale control socket file.
 - **Solution:** Simplify p2p.conf, manually remove /var/run/wpa_supplicant/wlan0, and ensure wpa_supplicant starts before wpa_cli.
- **p2p_group_add Fails:**
 - **Cause:** wpa_supplicant is not running or not in the correct state.

- **Solution:** Ensure wpa_supplicant is running, check its logs (journalctl -u wpa_supplicant) for initialization errors.
- **dnsmasq Fails (Cannot assign IP):**
 - **Cause:** dnsmasq not configured for the correct P2P interface (p2p-wlan0-0), or the listen-address is wrong.
 - **Solution:** Ensure dnsmasq.conf has interface=p2p-wlan0-0 and the correct listen-address and dhcp-range.
- **Phone Connects but No IP or No Internet:**
 - **Cause:** dnsmasq is not running, or not configured for p2p-wlan0-0, or wpa_supplicant didn't assign an IP.
 - **Solution:** Ensure dnsmasq is running and configured for p2p-wlan0-0 with a dhcp-range or restart the server

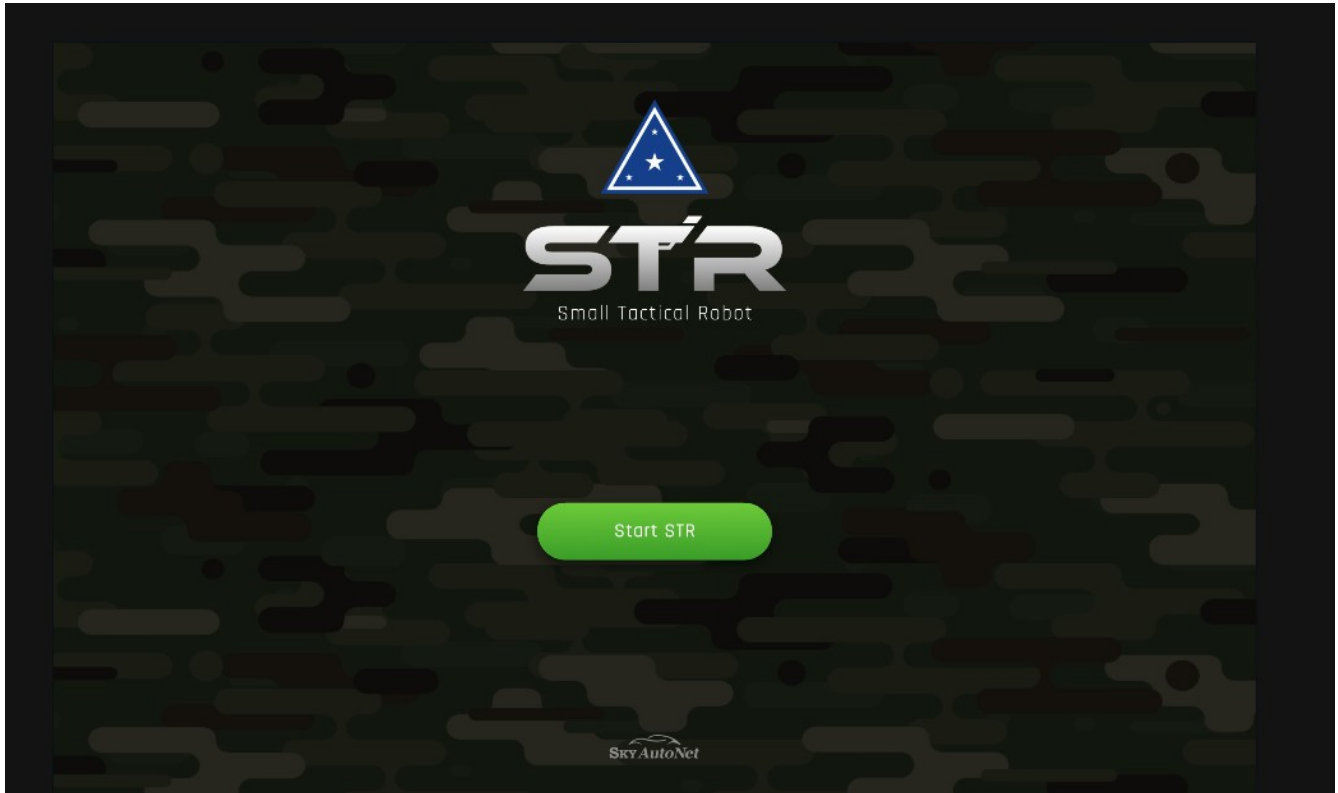
Android Tablet App Configuration

Installation

Install the provided **str.apk** file onto your Android tablet.

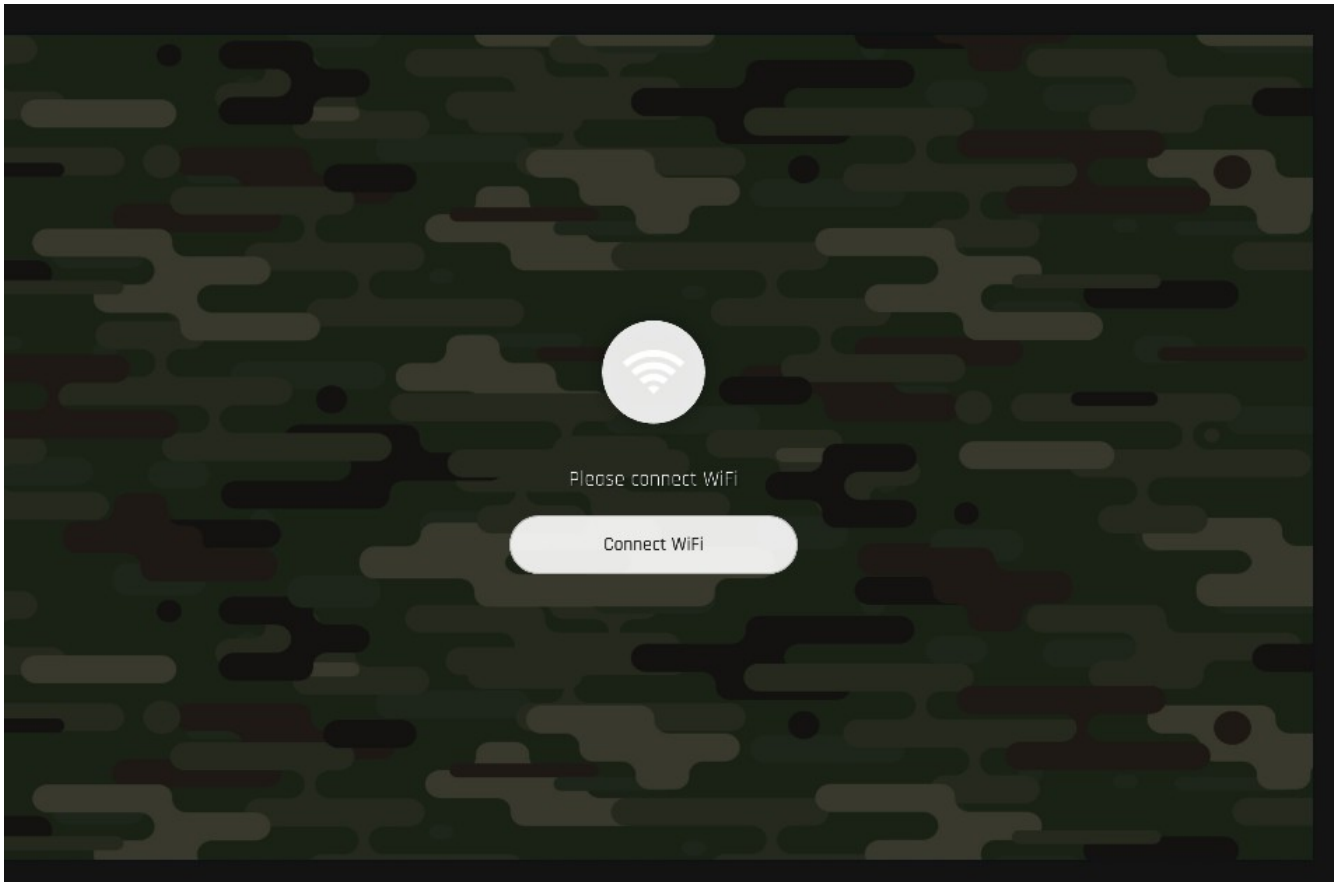
Step 1: Initial Setup (Splash & WiFi Screens)

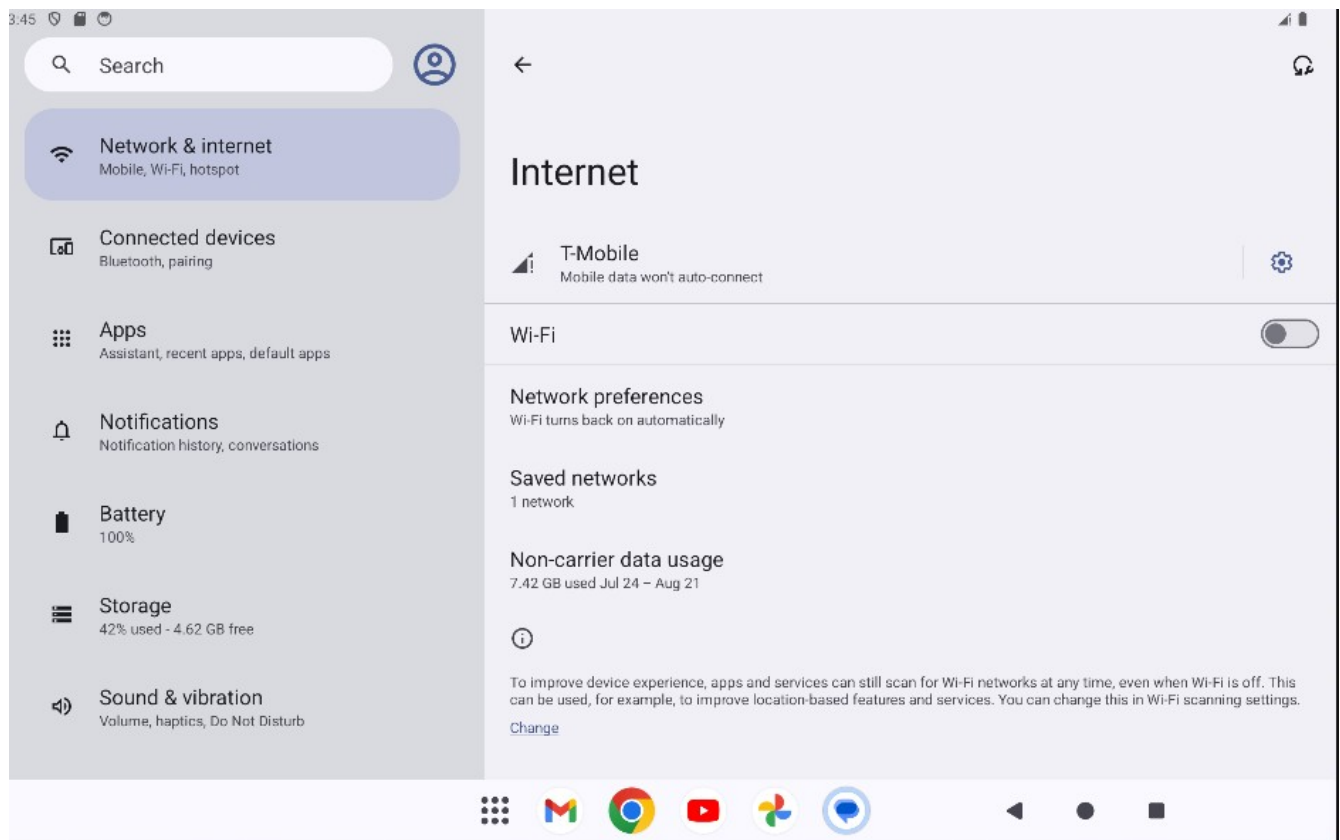
1. **Launch the App:** Tap the app icon to open it. You will be greeted with the **Splash Screen**.



2. **Press "Start STR":** This will take you to the network setup screen.
3. **Connect to the Robot's Network:** The next screen ensures the tablet is connected to the correct WiFi network. **IF WIFI is NOT CONNECTED**, the
 - Press the **"Connect WiFi"** button. This will open the tablet's system WiFi settings.
 - Connect to the **same WiFi network** that the Raspberry Pi is connected to. Named will start with "DIRECT-.."
 - Once connected, use the system's back navigation to return to the app. The app will detect the connection and the button will change to **"Go to Home"**.

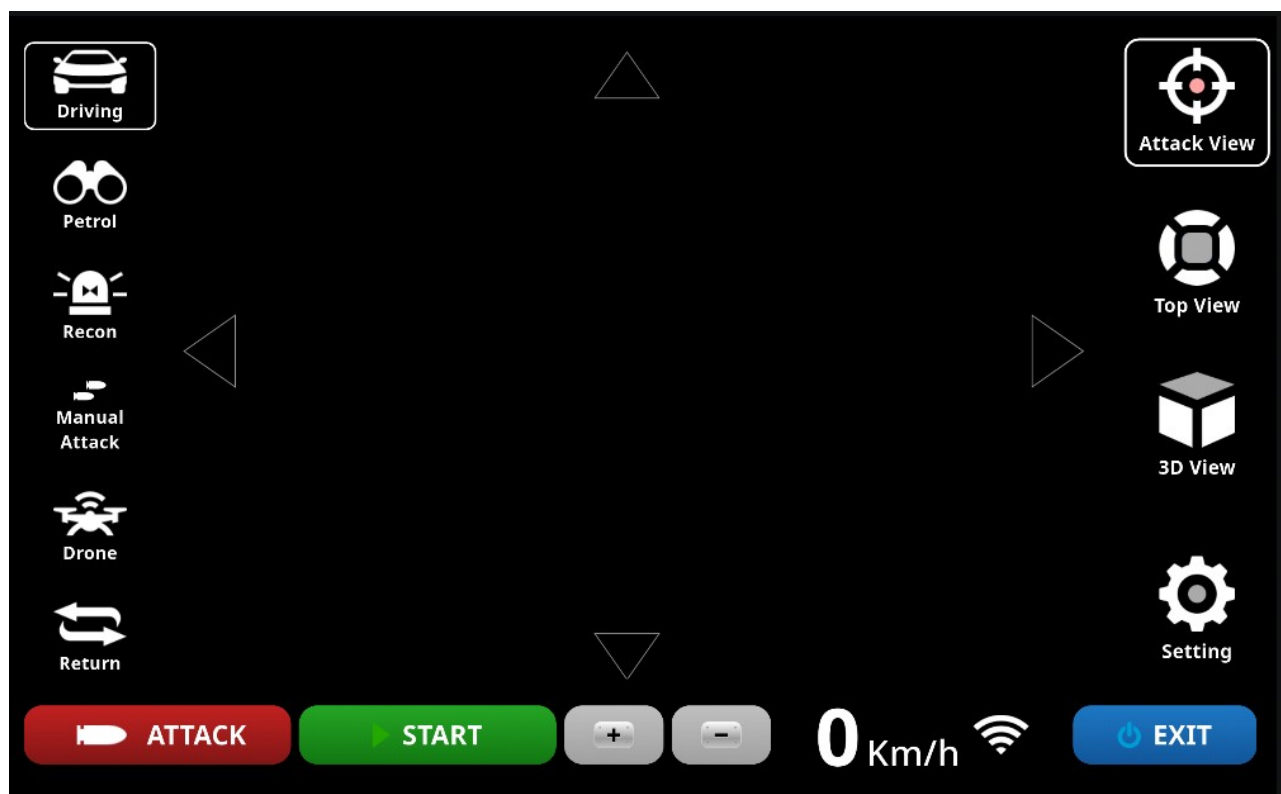
- Press "**Go to Home**" to proceed to the main control screen.





Step 2: Configuring the IP Address and Camera URLs

1. **Open Settings:** On the main control screen, tap the "**Setting**" button on the bottom right.



← Settings

Robot IP Address

192.168.0.211

Camera 1 URL

rtsp://192.168.0.211:8554/cam0

Camera 2 URL

rtsp://192.168.0.211:8554/cam0

Camera 3 URL

rtsp://192.168.0.158:8554/cam0

Save Changes

2. **Enter IP and URLs:** You will be taken to the Settings menu.

- **Robot IP Address:** In this field, enter the IP address of your Raspberry Pi **p2p-wlan0-0** that you found in **Part 1**, right now the IP will be the p2p new wifi-ip (**e.g., 192.168.49.1**).
- **Camera URLs:** You must also update the IP address portion of each camera URL to match. For example:
 - rtsp://192.168.49.1:8554/cam0
 - rtsp://192.168.49.1:8554/cam1
 - rtsp://192.168.49.1:8554/cam2

3. **Save Changes:** Press the "**Save Changes**" button at the bottom. Your settings are now saved permanently on the tablet. The app will remember these settings even if you close and reopen it.

4. **Return to Control Screen:** Use the back arrow at the top-left to return to the main control screen. The app will automatically restart the video stream using the new addresses. You should now see the live video from the Raspberry Pi camera.

Basic Operation

- **Video Feed:** The live video from the currently selected camera is displayed in the background.
- **Mode Selection (Left Buttons):** Tap buttons like Driving, Petrol, Recon to change the robot's primary command_id. The selected mode will be highlighted.
- **Camera Selection (Right Buttons):** Tap Attack View, Top View, 3D View to switch between the different RTSP video streams.