Klair Dashboard

Hardware Assembly Guide

Raspberry Pi 4 Desk Dashboard with Presence Detection

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Contents

1. Parts List

Verify you have all components before beginning assembly.

Component	Source	Price
Raspberry Pi 4 (4GB)	Already owned	—
Raspberry Pi Touch Display 2 - 7"	The Pi Hut	£57.60
Pibow Frame (Noir Black)	The Pi Hut	£15.00
NeoPixel Stick - 8x 5050 RGB LED	The Pi Hut (Adafruit)	£5.80
Waveshare mmWave Sensor (24GHz)	The Pi Hut	£2.90
Mini Breadboard (White)	The Pi Hut	£1.50
Jumper Wires (Female-Female)	The Pi Hut	~£3.00
MicroSD Card (32GB+)	Already owned / Any retailer	—
USB-C Power Supply (3A, 15W)	Official Pi PSU recommended	—

Estimated Total: ~£86

2. Tools & Materials Required

Essential Tools

1. Small Phillips screwdriver (for Pibow frame assembly)
2. Tweezers or small pliers (for handling small components)
3. Anti-static wrist strap or mat (recommended)
4. Good lighting
5. Magnifying glass (optional, for reading pin labels)

Optional but Recommended

- Soldering iron and solder (if NeoPixel needs header pins)
- Double-sided tape or mounting putty (for positioning sensors)
- Cable ties or velcro straps (for cable management)
- Heat shrink tubing (for tidy wire connections)
- Multimeter (for testing connections)

3. Safety Precautions

⚠️ IMPORTANT: Read all safety precautions before beginning.

- **Always disconnect power before making any connections.**
- Handle the Raspberry Pi and components by their edges to avoid static discharge.
- Double-check all wiring before applying power—incorrect connections can damage components permanently.
- The mmWave sensor operates at 3.3V—do not connect to 5V pins.
- The NeoPixel requires 5V power but its data line is 3.3V tolerant.
- Work on a clean, dry, non-conductive surface.
- Keep liquids away from your work area.

4. GPIO Pin Reference

The Raspberry Pi 4 has a 40-pin GPIO header. Below are the pins we will use for this project.

Pins Used in This Project

Pin #	Name	Purpose	Connected To
Pin 1	3.3V	Power	mmWave Sensor 3V3
Pin 2	5V	Power	NeoPixel VCC (5V)
Pin 6	GND	Ground	mmWave GND + NeoPixel GND
Pin 8	TXD (GPIO14)	UART Transmit	mmWave RX (optional)
Pin 10	RXD (GPIO15)	UART Receive	mmWave TX (optional)
Pin 11	GPIO17	Digital Input	mmWave OT2 (presence)
Pin 12	GPIO18	PWM0	NeoPixel DIN (data)

Note: The UART pins (8 and 10) are optional—they're only needed if you want to configure the mmWave sensor's sensitivity. For basic presence detection, only pins 1, 6, and 11 are required for the sensor.

5. Assembly Steps

Step 1: Prepare the Raspberry Pi

1. Ensure the Raspberry Pi is completely powered off and disconnected from any power source.
2. Insert your prepared MicroSD card (with Raspberry Pi OS) into the Pi's card slot.
3. Place the Pi on a clean, anti-static surface with the GPIO header facing up.

Step 2: Connect the Touch Display

1. The Raspberry Pi Touch Display 2 connects via DSI ribbon cable.
2. Locate the DSI connector on your Raspberry Pi 4 (the port labelled 'DISPLAY').
3. Gently lift the black plastic clip on the DSI connector.
4. Insert the ribbon cable with the metal contacts facing the circuit board.
5. Push the black clip back down to secure the cable.
6. Connect the other end to the display following the same process.

Step 3: Assemble the Pibow Frame

1. Follow the Pibow assembly instructions included with the frame.
2. Stack the acrylic layers in the correct order (they are usually numbered or colour-coded).
3. Mount the Raspberry Pi onto the display's mounting points.
4. Secure with the provided screws—do not overtighten.
5. Leave access to the GPIO header for sensor connections.

Step 4: Wire the mmWave Presence Sensor

The Waveshare mmWave sensor has 5 pins. For basic presence detection, you only need 3 connections.

Minimum Wiring (Presence Detection Only)

Sensor Pin	Wire Colour (suggested)	Pi GPIO Pin
3V3	Red	Pin 1 (3.3V)
GND	Black	Pin 6 (GND)
OT2 (presence output)	Yellow or Green	Pin 11 (GPIO17)

Full Wiring (Including UART for Configuration)

Add these connections if you want to configure sensor sensitivity via software:

Sensor Pin	Wire Colour (suggested)	Pi GPIO Pin
TX	Blue	Pin 10 (RXD)
RX	White	Pin 8 (TXD)

✓ **Tip: Note that TX connects to RX and RX connects to TX—this is intentional (transmit to receive).**

Step 5: Wire the NeoPixel LED Stick

The NeoPixel Stick requires 3 connections.

NeoPixel Pin	Wire Colour (suggested)	Pi GPIO Pin
5V / VCC	Red	Pin 2 (5V)
GND	Black	Pin 6 (GND) - shared
DIN (Data In)	Green or Yellow	Pin 12 (GPIO18)

ℹ **Note: Both the mmWave sensor and NeoPixel share Pin 6 (GND). You can either use a breadboard to split the ground connection, or use two separate GND pins (Pin 6 and Pin 14 are both GND).**
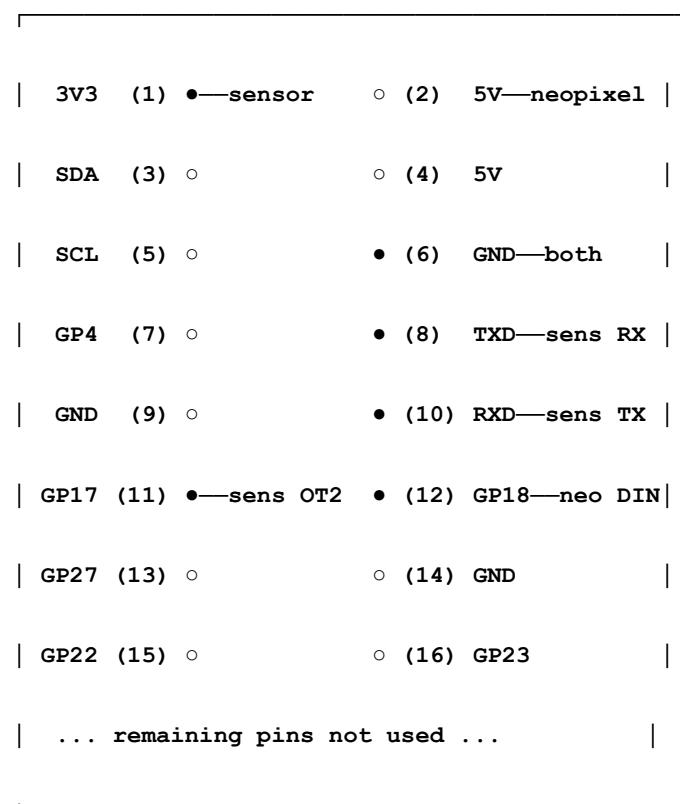
Step 6: Position and Mount Components

1. Position the NeoPixel stick on the back of the Pibow frame where it will cast light around the edges of the display. Use double-sided tape to secure.
2. Mount the mmWave sensor facing forward (towards where you will be sitting). It can be attached to the top edge of the frame or positioned slightly to the side.
3. Use the mini breadboard if needed to make connections easier and more secure.
4. Route wires neatly along the frame edges. Use cable ties to bundle excess wire.
5. Ensure no wires are under tension or at risk of being pulled loose.

6. Wiring Diagram

Complete wiring reference for all connections.

```
RASPBERRY PI 4 GPIO HEADER (Top View)


 ┌──────────────────────────────────────────┐


 │  3V3  (1) ●──sensor    ○ (2)  5V──neopixel │

 │  SDA  (3) ○            ○ (4)  5V           │

 │  SCL  (5) ○            ● (6)  GND──both    │

 │  GP4  (7) ○            ● (8)  TXD──sens RX │

 │  GND  (9) ○            ● (10) RXD──sens TX │

 │ GP17 (11) ●──sens OT2  ● (12) GP18──neo DIN│

 │ GP27 (13) ○            ○ (14) GND          │

 │ GP22 (15) ○            ○ (16) GP23         │

 │  ... remaining pins not used ...           │


 └──────────────────────────────────────────┘
```

```
● = Used    ○ = Not used
```

Connection Summary

- **mmWave Sensor:** Pin 1 (3V3), Pin 6 (GND), Pin 11 (GPIO17 for presence), optionally Pin 8 & 10 for UART
- **NeoPixel:** Pin 2 (5V), Pin 6 (GND), Pin 12 (GPIO18 for data)
- **Total wires:** 6 wires minimum (3 for sensor + 3 for NeoPixel)

7. Testing Procedure

Before running the dashboard software, verify all hardware is working correctly.

Pre-Power Checklist

1. Double-check all wire connections against the wiring tables above.
2. Ensure no bare wires are touching each other.
3. Verify 3.3V and 5V are not swapped (this can damage components).
4. Confirm the DSI cable is properly seated at both ends.

Initial Power-On Test

- Connect the USB-C power supply to the Raspberry Pi.
- The Pi should boot and the display should show the Raspberry Pi OS desktop.
- Touch the screen to verify touch input is working.

Test the mmWave Sensor

Open a terminal on the Raspberry Pi and run the following Python script:

```python
import RPi.GPIO as GPIO

import time



PRESENCE_PIN = 17

GPIO.setmode(GPIO.BCM)

GPIO.setup(PRESENCE_PIN, GPIO.IN)



print("Testing presence sensor...")

print("Wave your hand or move in front of the sensor.")

print("Press Ctrl+C to exit.")



try:

    while True:

        if GPIO.input(PRESENCE_PIN):

            print("DETECTED: Human present")

        else:
```

```
        print("No presence detected")

    time.sleep(0.5)

except KeyboardInterrupt:

    GPIO.cleanup()
```

Test the NeoPixel

First, install the NeoPixel library, then run a test script:

```
sudo pip3 install rpi_ws281x adafruit-circuitpython-neopixel

sudo python3 -c "

import board

import neopixel

pixels = neopixel.NeoPixel(board.D18, 8, brightness=0.3)

pixels.fill((255, 0, 0))  # Red

import time; time.sleep(2)

pixels.fill((0, 255, 0))  # Green

time.sleep(2)

pixels.fill((0, 0, 255))  # Blue

time.sleep(2)

pixels.fill((0, 0, 0))    # Off

"
```

⚠️ **Important: NeoPixel control requires root/sudo privileges due to direct hardware access.**

8. Troubleshooting

Display Issues

- **Display is blank:** Check DSI cable connection. Ensure cable is not twisted or damaged. Try reseating the cable.
- **Touch not working:** The Touch Display 2 should work without additional USB connection. If issues persist, check for OS updates.
- **Display upside down:** Add 'lcd_rotate=2' to /boot/config.txt to rotate 180 degrees.

mmWave Sensor Issues

- **Always shows 'present':** Check for reflective surfaces or movement in the detection range. Try adjusting position.
- **Never detects presence:** Verify 3.3V power is connected. Check OT2 wire connection to GPIO17. Ensure sensor is facing correct direction.
- **Erratic detection:** mmWave can detect through thin walls—ensure no one is moving in adjacent rooms/areas.

NeoPixel Issues

- **LEDs not lighting:** Verify 5V power connection. Ensure DIN (not DOUT) is connected to GPIO18. Run test script with sudo.
- **Wrong colours:** Some NeoPixels are GRB not RGB. Check library colour order setting.
- **Flickering:** Check for loose connections. Ensure adequate power supply (3A recommended).
- **Permission denied:** NeoPixel requires root. Use 'sudo' when running Python scripts.

Power Issues

- **Lightning bolt icon on screen:** Under-voltage warning. Use official 3A power supply. Reduce LED brightness.
- **Random reboots:** Insufficient power. Check all connections. Try different power supply.

9. Software Setup Notes

After hardware assembly is complete, you will need to:

- Install Raspberry Pi OS (64-bit recommended)
- Enable UART for sensor configuration (optional): sudo raspi-config → Interface Options → Serial Port
- Install Node.js and npm for the Next.js dashboard
- Install Python dependencies for hardware control (rpi_ws281x, RPi.GPIO)
- Configure the dashboard to auto-start on boot
- Set up Home Assistant on your N100 server for environmental data (optional)

— End of Assembly Guide —