Internet of Things Simple Application on RPi

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- The Raspberry Pi is capable of doing all the things you'd expect from a computer.
- Everything from browsing the internet and playing games, to watching movies and listening to music.
- Raspberry Pi is known as a single-board computer, but that doesn't mean it's not powerful.
- Raspberry Pi can do anything a bigger computer can do.
- Over the years, the Raspberry Pi has evolved, increasing its memory, improving its performance, and adding features.

Raspberry Pi 3 Model B+



Raspberry Pi 3 Model B+: Specifications

ProcessorBroadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHzMemory1GB L PDDR2 SDR AM									
Memory	1GB LPDDR2 SDRAM								
Connectivity	 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2, BLE Gigabit Ethernet over USB 2.0 4 × USB 2.0 ports 								
Access	Extended 40-pin GPIO header								
Video & Sound	 1 × full size HDMI MIPI DSI display port MIPI CSI camera port 4 pole stereo output and composite video port 								
SD Card Support	Micro SD format for operating system and data storage								



Raspberry Pi: GPIO

The GPIO (General-Purpose Input/Output) header is a feature of the Raspberry Pi used to talk to additional hardware such as LEDs and buttons and sensors.



Raspberry Pi: GPIO



1					
	Alternate Function				Alternate Function
		3.3V PWR	1	2 5V PWR	
	I2C1 SDA	GPIO 2	3	4 5V PWR	
	12C1 SCL	GPIO 3	5	6 GND	
		GPIO 4	7	8 UARTO TX	
		GND	9	10 UARTO RX	
		GPIO 17	11	12 GPIO 18	
		GPIO 27	13	14 GND	
		GPIO 22	15	16 GPIO 23	
		3.3V PWR	17	18 GPIO 24	
	SPI0 MOSI	GPIO 10	19	20 GND	
	SPI0 MISO	GPIO 9	21	22 GPIO 25	
	SPI0 SCLK	GPIO 11	23	24 GPIO 8	SPI0 CS0
		GND	25	26 GPIO 7	SPI0 CS1
		Reserved	27	28 Reserved	
		GPIO 5	29	30 GND	
		GPIO 6	31	32 GPIO 12	
		GPIO 13	33	34 GND	
	SPI1 MISO	GPIO 19	35	36 GPIO 16	SPI1 CS0
		GPIO 26	37	38 GPIO 20	SPI1 MOSI
		GND	39	40 GPIO 21	SPI1 SCLK

Raspberry Pi: GPIO

3.3V	01		02	5V
GPIO 02	03	$\bigcirc \bigcirc$	04	5V
GPIO 03	05	$\bigcirc \bigcirc$	06	GND
GPIO 04	07	$\bigcirc \bigcirc$	08	GPIO 14
GND	09		10	GPIO 15
GPIO 17	11	$\bigcirc \bigcirc$	12	GPIO 18
GPIO 27	13		14	GND
GPIO 22	15	$\bigcirc \bigcirc$	16	GPIO 23
3.3V	17		18	GPIO 24
GPIO 10	19	$\bigcirc \bigcirc$	20	GND
GPIO 09	21	$\bigcirc \bigcirc$	22	GPIO 25
GPIO 11	23	$\bigcirc\bigcirc$	24	GPIO 8
GND	25	$\bigcirc \bigcirc$	26	GPIO 7
ID_SD	27	$\bigcirc\bigcirc$	28	ID_SC
GPIO 05	29		30	GND
GPIO 06	31	$\bigcirc \bigcirc$	32	GPIO 12
GPIO 13	33		34	GND
GPIO 19	35	$\bigcirc \bigcirc$	36	GPIO 16
GPIO 26	37	$\bigcirc \bigcirc$	38	GPIO 20
GND	39		40	GPIO 21

Raspberry Pi: GPIO Template



Turning on an LED

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οwe	GPIO 02 0	3	04	5V			۲	۲		•	•		•	•			•		•	
5	GPIO 03 0	5	06	GND			-			•	•	•	•		•	•	•		•	•
	GPIO 04 0	7	08	GPIO 14			۲	۲	5	•	•	•	•	•	•		•	5	•	•
	GND 0	9	10	GPIO 15						•	•	•		•	•		•			
	GPIO 17 1	1	12	GPIO 18			۲	۲		•	•	•	•		•		•		۲	•
	GPIO 27 1	3	14	GND			-	-	-	•	2	•		-	•		•		•	•
	GPIO 22 1	5	16	GPIO 23			۲	۲		-	2			1	1		•		•	•
	3.3V 1	7	18	GPIO 24			۲	-		Ū,				1	-	7 °	•	10	٠	•
HDY	GPIO 10 1	9 0 0	20	GND			۲	۲		•	•	•	•	•	•		•		۲	0
	GPIO 09 2	1	22	GPIO 25							•	•	•		•		•			
	GPIO 11 2	3	24	GPIO 8			۲	۲									•		۲	0
	GND 2	5	26	GPIO 7			۲	۲			•				•		•	1) (۲	•
	ID_SD 2	7 00	28	ID_SC			۲	۲	15	2	•		•	2	•			15	•	•
	GPIO 05 2	9	30	GND			۲	۲		2				2					•	0
	GPIO 06 3	1	32	GPIO 12			۲	۲											۲	•
(ZI (CAMERA)	GPIO 13 3	3	34	GND						2				-	•					
	GPIO 19 3	5	36	GPIO 16			۲	۲											•	0
	GPIO 26 3	7	38	GPIO 20			۲	۲	20									20	۲	•
	GND 3	9 🔴 🔵	40	GPIO 21			۲	۲		•			•	•					•	
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 Connect breadboard power (+) and ground (-) rails to Arduino 5V and ground (GND), respectively.

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3.3V	01	02	5V	•	0				1			•	•		2			•		•	
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GPIO 03	05	06	GND		G							•	•					•		۲	۲
GPIO 04	07	08	GPIO 14	6		۲			5			•	•					•	5	۲	
GND	09	10	GPIO 15						9			•	•	2	25		2	•			
GPIO 17	11	12	GPIO 18			۲			9		•	•	•		2.5			•		•	
GPIO 27	13	14	GND			۲					•	•	•		2			•		۲	۲
GPIO 22	15	16	GPIO 23			۲			0		•	•	•	•	0	0		•		۲	
3.3V	17	18	GPIO 24			۲			10	9			۲		9		•	•	10	•	•
GPIO 10	19	20	GND			۲			9	•	•	•	۲					•		•	
GPIO 09	21	22	GPIO 25								•	•	۲	•		•		•			
	23	24	GPIO 8						0		•	•	۲	•		•	•	•			
GND	25	26	GPI0 7						0		•		۲	•) •		•	•	•			
	27	28							15		•		۲	•		•		•	15		

2. Plug the LED into two different breadboard rows.



3. The cathode (shorter leg) connects to one leg of a resistor of 330Ω , and the other resistor leg to the ground.



4. Wire up the LED anode (longer leg) to the power.



Your First Raspberry Pi Project: Blinking an LED



 Connect breadboard power (+) and ground (-) rails to Arduino 5V and ground (GND), respectively.

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GPI	04 07	ŏŎ	08	GPIO 14					•	5	۲	•	•	•) (•		۲	•	۲	۲	5			6
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GPIC	17 11	ÕÕ	12	GPIO 18) (•		۲	۲	•	•	•	•	۲	۲	•	۲				6
GPIC	27 13	\bigcirc	14	GND)	•		•	•	•	•	•	•	۲	•	•	•				6
GPIC	22 15	$\bigcirc \bigcirc$	16	GPIO 23			۲) (•		•	•	•	•	•		۲	۲	•	•				6
	.3V 17	\mathbf{O}	18	GPIO 24	0		٠) (•	10	۲	•	•	•	•		۲	•	۲	•	10			6
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GPIC GPIC	09 21	$\bigcirc \bigcirc$	22	GPIO 25							•	•	•	•	•	•	۲	•	•	۲				
	0 11 23	ÕÕ	24	GPIO 8	0) (•		۲	•	0	•	•	•	۲	•	•					6
	ND 25	•0	26	GPIO 7					•		۲	•	•	•	•	۲	۲	٠	•	۲		•		
ID	SD 27	00	28	ID_SC			۲) (•	15	•	•	•	•	•	•	۲	•	•		15			6

2. Plug the LED into two different breadboard rows.



3. The cathode (shorter leg) connects to one leg of a resistor of 330Ω , and the other resistor leg to the ground.



4. Wire up the LED anode (longer leg) to Arduino pin 11 (GPIO 17).



- Open Mobile hotspot, and make sure your Wi-Fi info is correct.
- Make sure to turn on the hotspot.

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		Share my Internet connection from
₿	Status	Wi-Fi 🗸
(i.	Wi-Fi	Share my Internet connection over
朢	Ethernet	• Wi-Fi
(C≊	Dial-up	O Bluetooth
%	VPN	Network name: iotlab
Л.		Network password: hostiotlab
57	Airplane mode	Network band: 2.4 GHz
((p))	Mobile hotspot	Edit

- After connecting your Raspberry Pi to power, it will be connected to your Wi-Fi automatically and have an IP address.
- Open Mobile hotspot, and copy that IP address.

Network name:	iotlab	
Network password:	hostiotlab	
Network band:	2.4 GHz	
Edit		
Devices connected:	2 of 8	
Device name	IP address	Physical address (MAC)
Galaxy-J4	192.168.137.50	
pi	192.168.137.206	

• Open VNC Viewer, and Enter the IP address of your RPi.

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	Sign in	•
ι.		

• Enter your username and password, and click Ok.

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	Username:	pi			
	Password:	••		Ø [
	Remember	password	Forgot pass	sword?	
	Catchphrase:	Bridge stick puma. Aug	gust forward twi	st.	
	Signature:	3c-4e-1f-60-d8-91-2c-	-75		
			K-Can	cel	
		3.00			

from RPi import GPIO
from time import sleep

pin = 11
GPIO.setmode(GPIO.BOARD)
GPIO.setup(pin, GPIO.OUT)

```
while True:
    GPIO.output(pin, 1)
    sleep(1)
```

```
GPIO.output(pin, 0)
sleep(1)
```

Import GPIO

Import sleep function

Set pin number # Use board pin numbering # Set pin 11 as output

Turn the LED on # Wait for a second

Turn the LED off
Wait for a second

Your First Raspberry Pi Project: Alternative Code

from RPi import GPIO
from time import sleep

pin = 17
GPIO.setmode(GPIO.BCM)
GPIO.setup(pin, GPIO.OUT)

```
while True:
    GPIO.output(pin, 1)
    sleep(1)
```

```
GPIO.output(pin, 0)
sleep(1)
```

Import GPIO

Import sleep function

Set pin number (GPIO 17)
Use GPIO pin numbering
Set GPIO 17 as output

Turn the LED on
Wait for a second

Turn the LED off
Wait for a second

Smart Home

• We want to build a simple app to turn on/off an LED via a webpage.



Smart Home: Circuit

• We will use the same connections.



• Create a new folder named Home.



Open Thonny Python IDE to write some python code.



Click Save.

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• Save your file as home.py in the Home folder.

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• Create a new folder named templates in the Home folder.



Create a new file named home.html in the Home/templates folder.



Smart Home: Project Hierarchy

Home



Smart Home: Simple Idea

- When the user enters 0.0.0.0:5000/on, the LED turns on.
- When the user enters 0.0.0.0:5000/off, the LED turns off.





Smart Home: Python Code

from RPi import GPIO
from flask import Flask, render_template

pin = 11
GPI0.setmode(GPI0.BOARD)
GPI0.setup(pin, GPI0.OUT)

app = Flask(__name__)

```
@app.route('/')
def home():
    return render template('home.html')
```

```
@app.route('/on')
def led_on():
    GPIO.output(pin, 1)
    return render_template('home.html')
```

```
@app.route('/off')
def led_off():
    GPIO.output(pin, 0)
    return render_template('home.html')
```

```
if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000)
```

Import GPIO
Import Flask

Set pin number
Use board pin numbering
Set pin 11 as output

Create Flask object

Go to home page

Turn the LED on # Go to home page

Turn the LED off
Go to home page

Start the server (0.0.0.0:5000)

<!DOCTYPE html>

```
<html>
<head>
<title>My Home</title>
</head>
```

```
<body>
<h1>Raspberry Pi Server</h1>
<a href="/on">Turn On</a>
<a href="/off">Turn Off</a>
</body>
</html>
```

Smart Home: HTML

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Raspberry Pi Server

<u>Turn On</u> <u>Turn Off</u>

Smart Home: Better Look

```
<!DOCTYPE html>
<html>
<head>
    <title>My Home</title>
    <style>
        body{text-align: center; font-family: Arial;}
        .btn{
                font-size: 15px;
                padding: 10px;
                margin: 10px;
                border-radius: 25px;
                text-decoration: none;
        }
        .on{background-color: lightseagreen; color: white;}
        .off{background-color: tomato; color: white;}
    </style>
</head>
<body>
    <h1>Raspberry Pi Server</h1>
    <a href="/on" class="btn on">Turn On</a>
    <a href="/off" class="btn off">Turn Off</a>
</body>
</html>
```

Smart Home: Better Look



Smart Home: Accessing Webserver From Anywhere

- After connecting your Raspberry Pi to power, it will be connected to your Wi-Fi automatically and have an IP address.
- Open Mobile hotspot, and copy that IP address.

Network name:	iotlab	
Network password:	hostiotlab	
Network band:	2.4 GHz	
Edit		
Devices connected:	2 of 8	
Device name	IP address	Physical address (MAC)
Galaxy-J4	192.168.137.50	
pi	192.168.137.206	

Smart Home: Accessing Webserver From Anywhere

- The copied IP is **192.168.137**.
- Open the browser and go to 192.168.137.206:5000.



Control High Voltage Devices



Control High Voltage Devices



Control High Voltage Devices



References

- How to Use Raspberry Pi GPIO Pins
- <u>GPIO Programming on the Raspberry Pi</u>
- Raspberry Pi GPIO Tutorial: The Basics
- Python WebServer With Flask and Raspberry Pi
- Raspberry Pi GPIO Home Automation
- Python (RPi.GPIO) API
- RPi.GPIO Basics
- Configure Flask Server to be Visible Across the Network
- <u>Arduino Connection with Relay Module</u>
- ESP32 Relay
- Relay Module with Arduino