

# How to use MATLAB with Raspberry Pi to Collect and Analyze Data from Sensors and Imaging Devices

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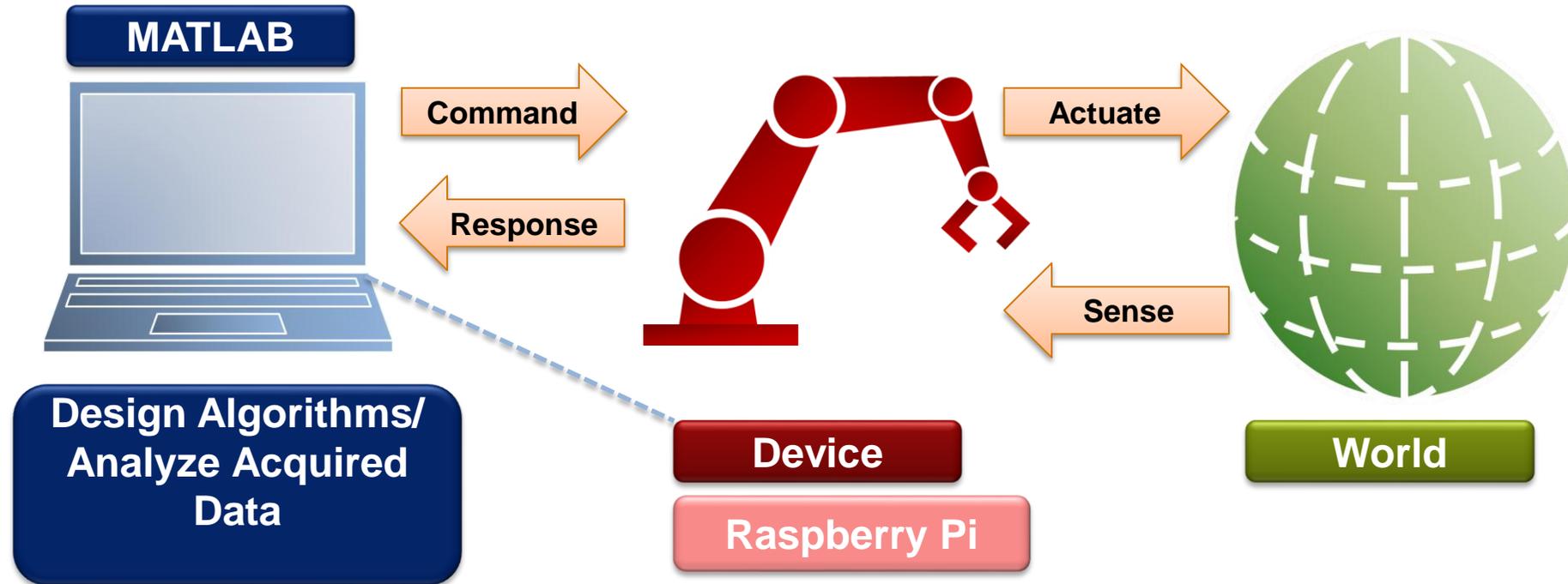


# Agenda

- Introduction to MATLAB
- Installation of Support Package
  - Setting up MATLAB to talk to your Raspberry Pi
- Camera Board demo
  - [Setting up Camera Board and detecting faces](#)
- I2C and SPI sensor demos
  - [Sparkfun TMP102 Temperature sensor](#)
    - Setting up sensor and plotting temperature data
  - [Sparkfun LIS331 Triple axis accelerometer](#)
    - Setting up sensor and taking measurements
    - Using data to visualize orientation
- Conclusion and Additional Resources

# Introduction to MATLAB

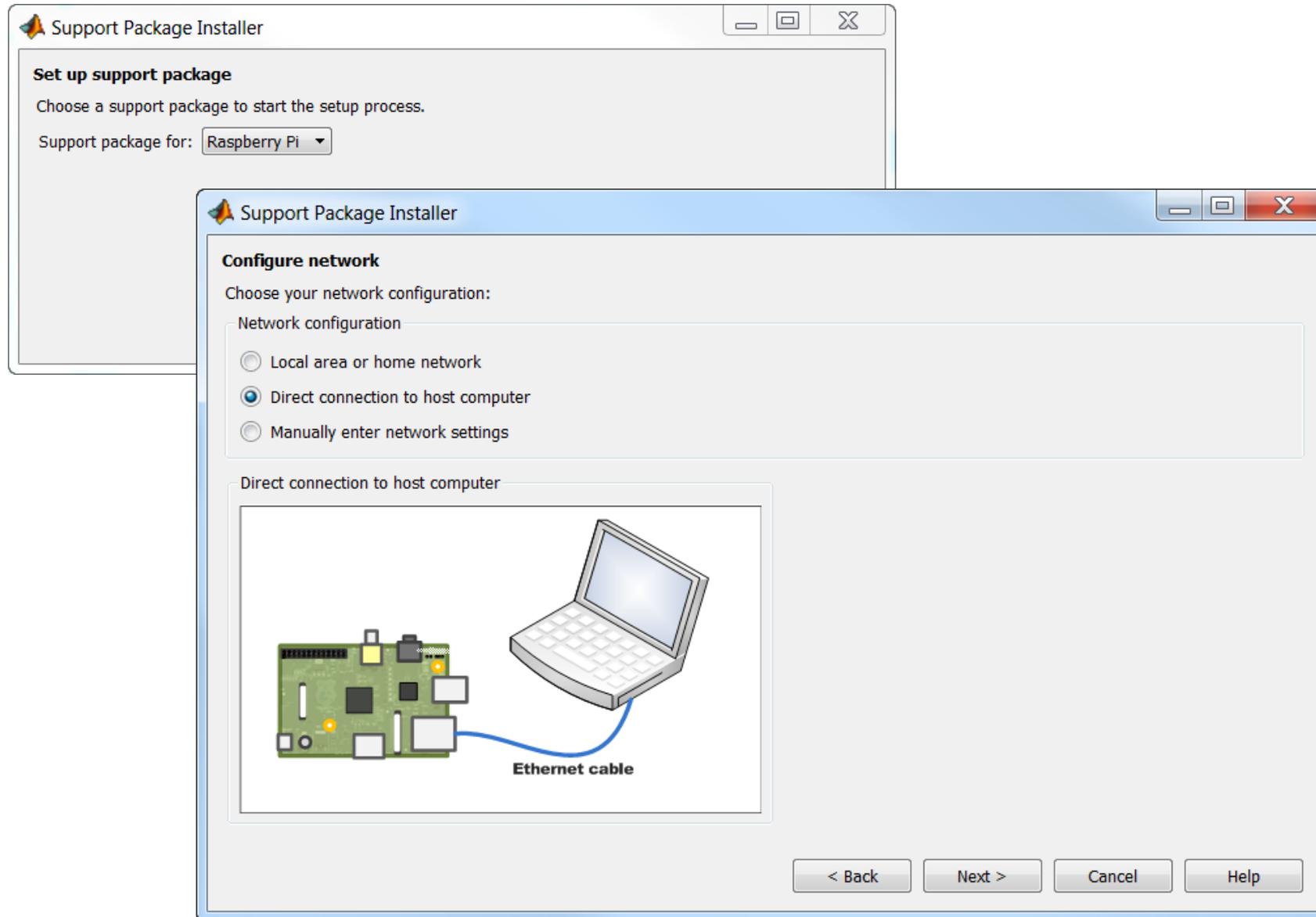
# Using MATLAB with Raspberry Pi



# Installing Raspberry Pi Support for MATLAB



# Setting up Support Package



# Uploading firmware

The image displays three overlapping windows from the 'Support Package Installer' application, illustrating the steps to upload firmware to a Raspberry Pi.

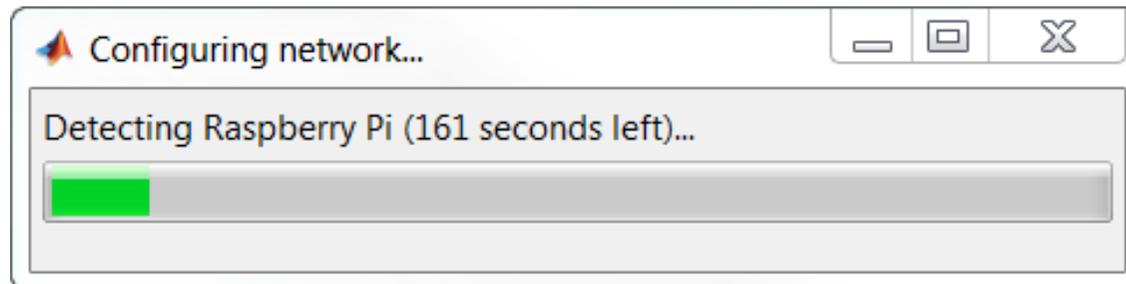
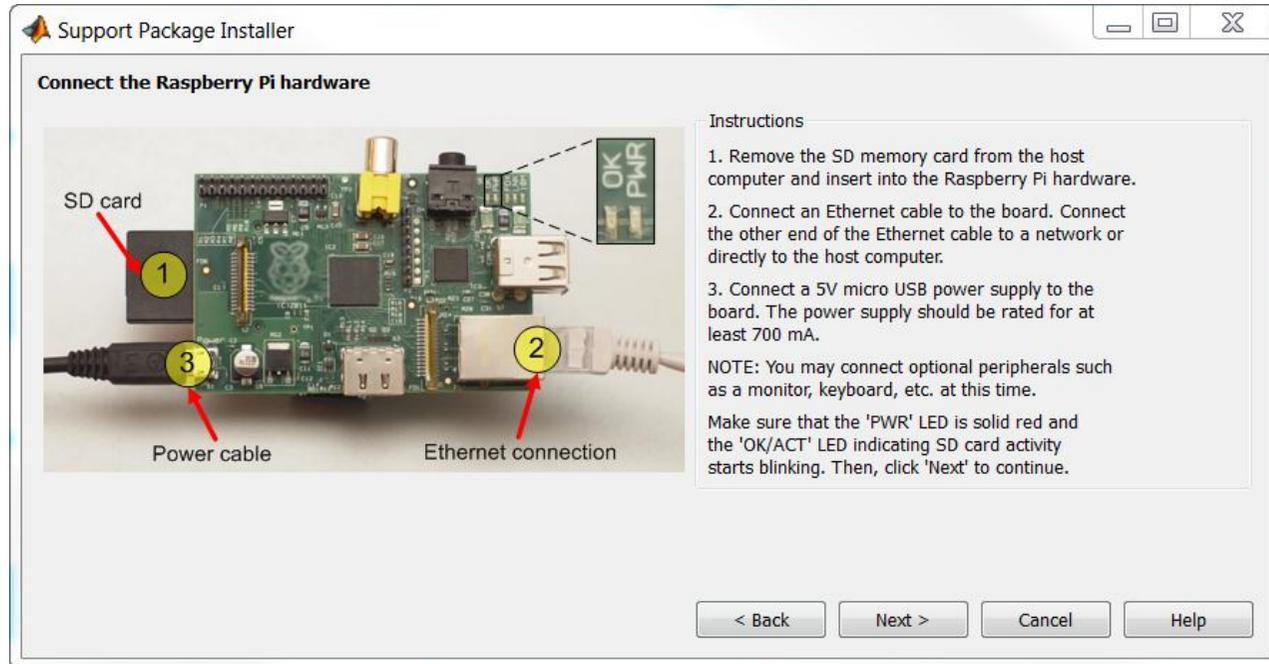
**Update firmware**  
The firmware update process for Raspberry Pi hardware consists of copying a Raspbian Wheezy Linux firmware image onto a memory card and booting the Raspberry Pi with this memory card. We will guide you through this process. Click "Next" to get started.

**Select a drive**  
Insert a 4 GB or larger SD memory card into a memory card reader on the host computer.  
Select the drive letter that corresponds to the memory card reader:  
Drive:    
If you do not find the memory card reader in the list of drives, reinsert the memory card fully and click "Refresh".

**Writing firmware image to SD card...**  
52% of 2825MB (4 min 55 seconds left)

Slide lock switch up to unlocked

# Detecting Raspberry Pi



# Completing Installation

Support Package Installer

**Confirm board configuration**

If you want to log in to the board in the future, the host name, IP address, user name, and password are displayed below.

IP address:

Host name:

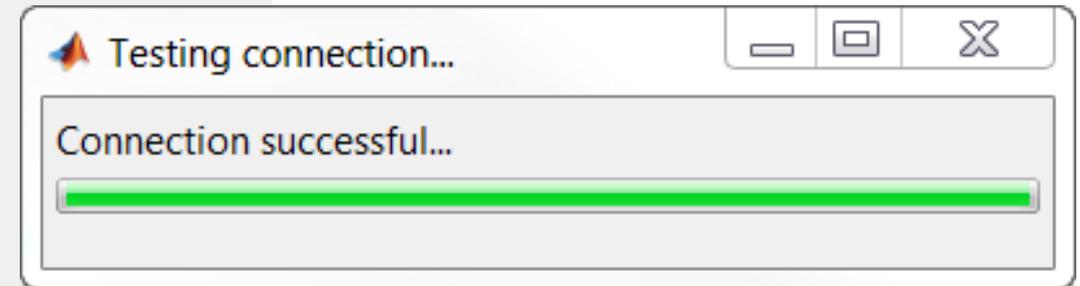
User name:

Password:

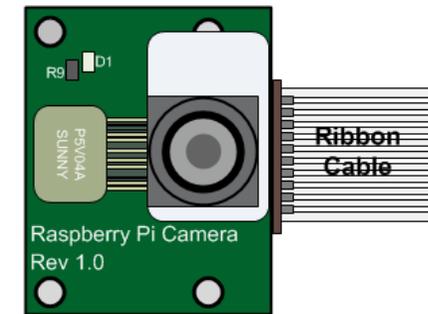
NOTE:

1. Your Raspberry Pi hardware will speak its IP address through the analog audio connector when it boots.
2. You can configure your Raspberry Pi hardware to automatically send an e-mail when IP address changes. Click 'Help' for detailed instructions.

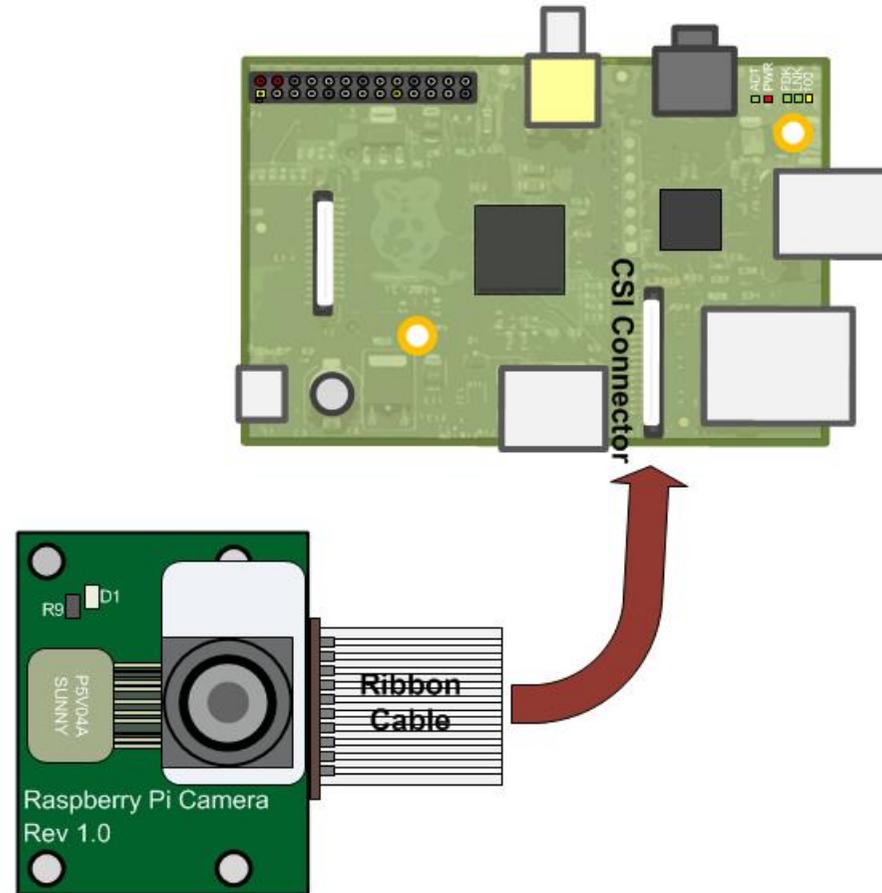
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# Demo: Capturing an image with the Camera Board and Detecting Faces



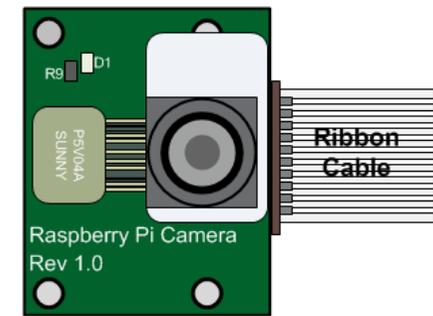
# Connecting the Camera Board



## Summary: Using Camera Board from MATLAB

- Create raspi object
- Create Camera Board object
- View/Change Camera Board Settings
- Use snapshot to take acquire image
- Create loop to acquire video
- Perform face detection on the acquired video

```
myraspi = raspi;  
cam = cameraboard(myraspi, 'Resolution', '1280x720');  
cam.Brightness=70;  
image=snapshot(cam);  
imagesc(image) % view image
```



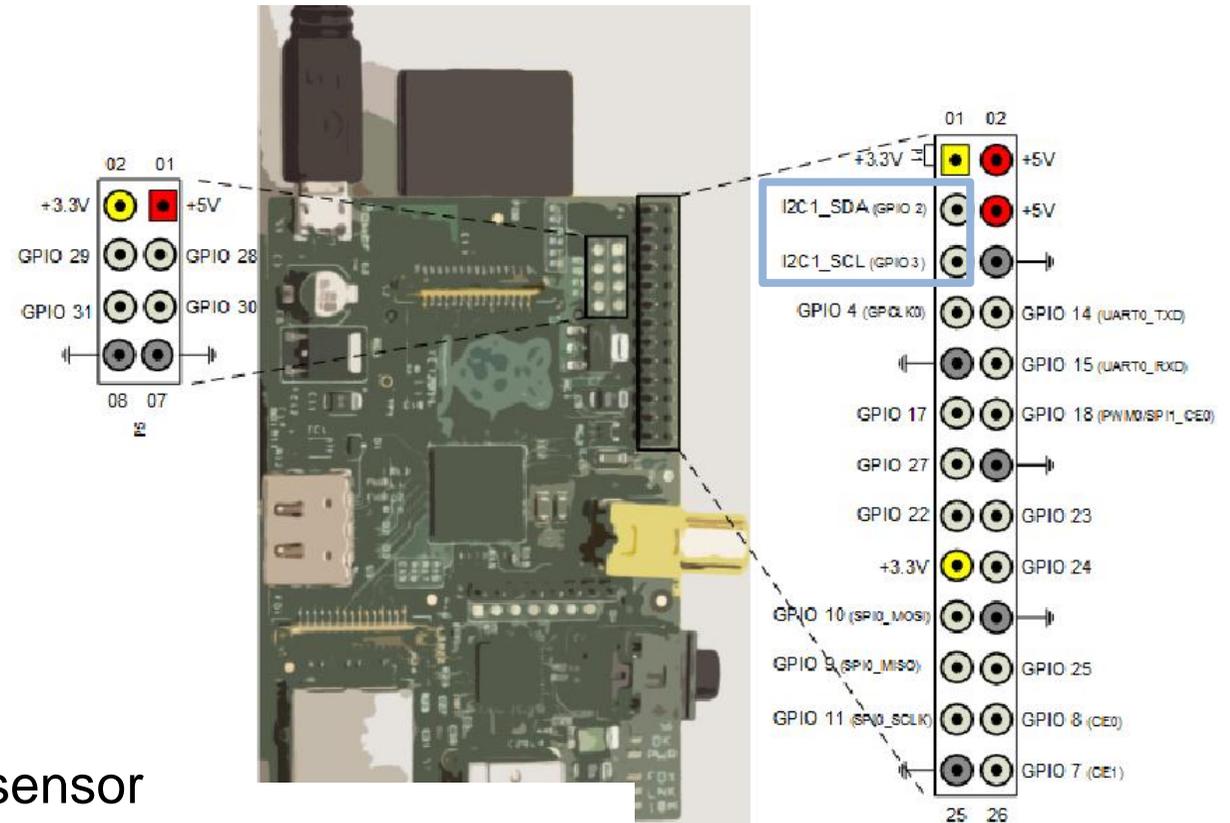
# Demo: Measuring temperature with an I2C temperature sensor



# Connecting an I2C sensor

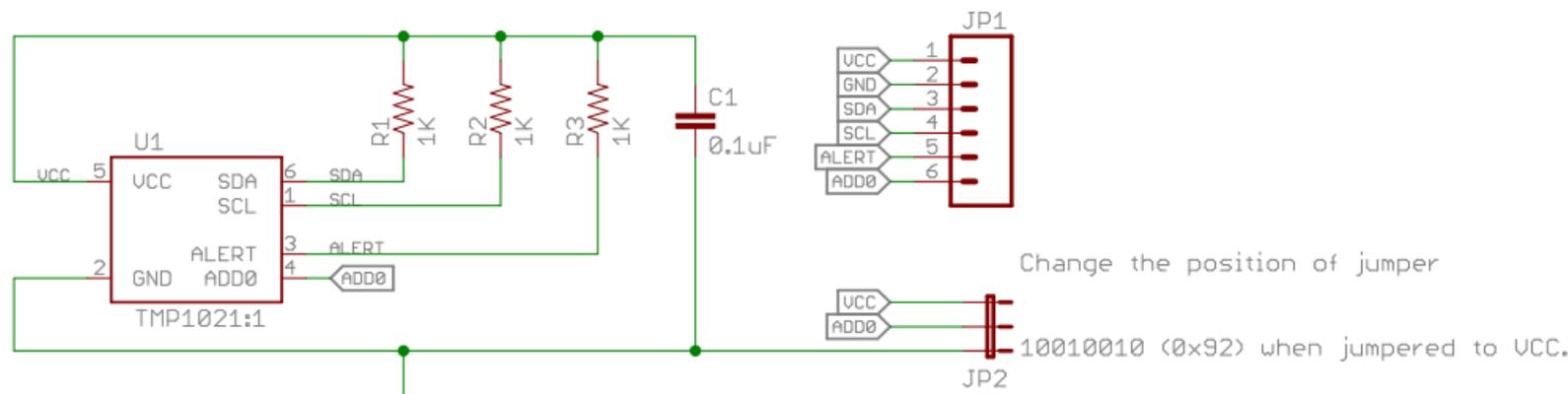
We need to connect:

- SDA to GPIO 2 (I2C1\_SDA)
- SCL to GPIO 3 (I2C1\_SCL)
- VCC to **3.3V**
- GND to GND
- ADD0 to GND



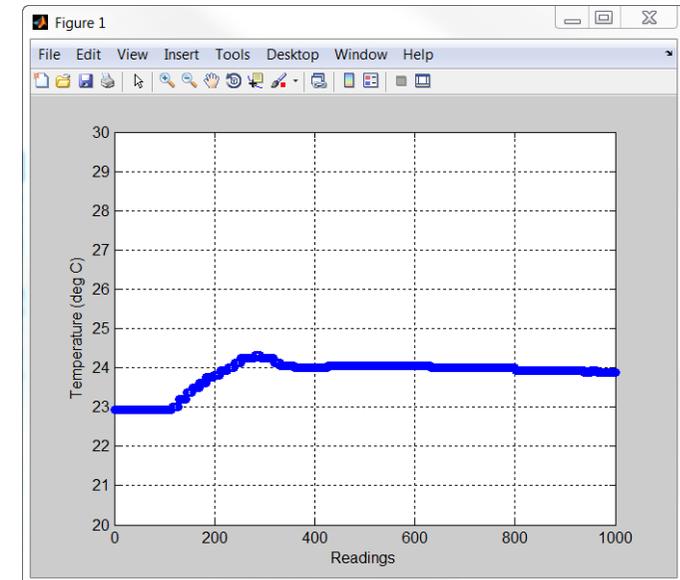
## Sensor pinout for TMP102 temperature sensor

Supply: 1.4V to 3.6V



## Summary: Reading from TMP102 I2C sensor

- Create raspi object
- Scan I2C bus for address of sensor (0x48)
- Create i2cdevice object
- Read temperature register
- Decode temperature using formula in datasheet



```
mypi = raspi;  
Active_Addresses = scanI2CBus(myapi, 'i2c-1'); % look for sensors on I2C bus  
tempsensor = i2cdev(myapi, 'i2c-1', '0x48'); % create temp sensor object  
temp = double(bitshift(swapbytes(tempsensor.readRegister(0, 'int16')), -4))...  
*.0625; % convert values to degrees C
```

# Demo: Orientation Sensing with an SPI accelerometer

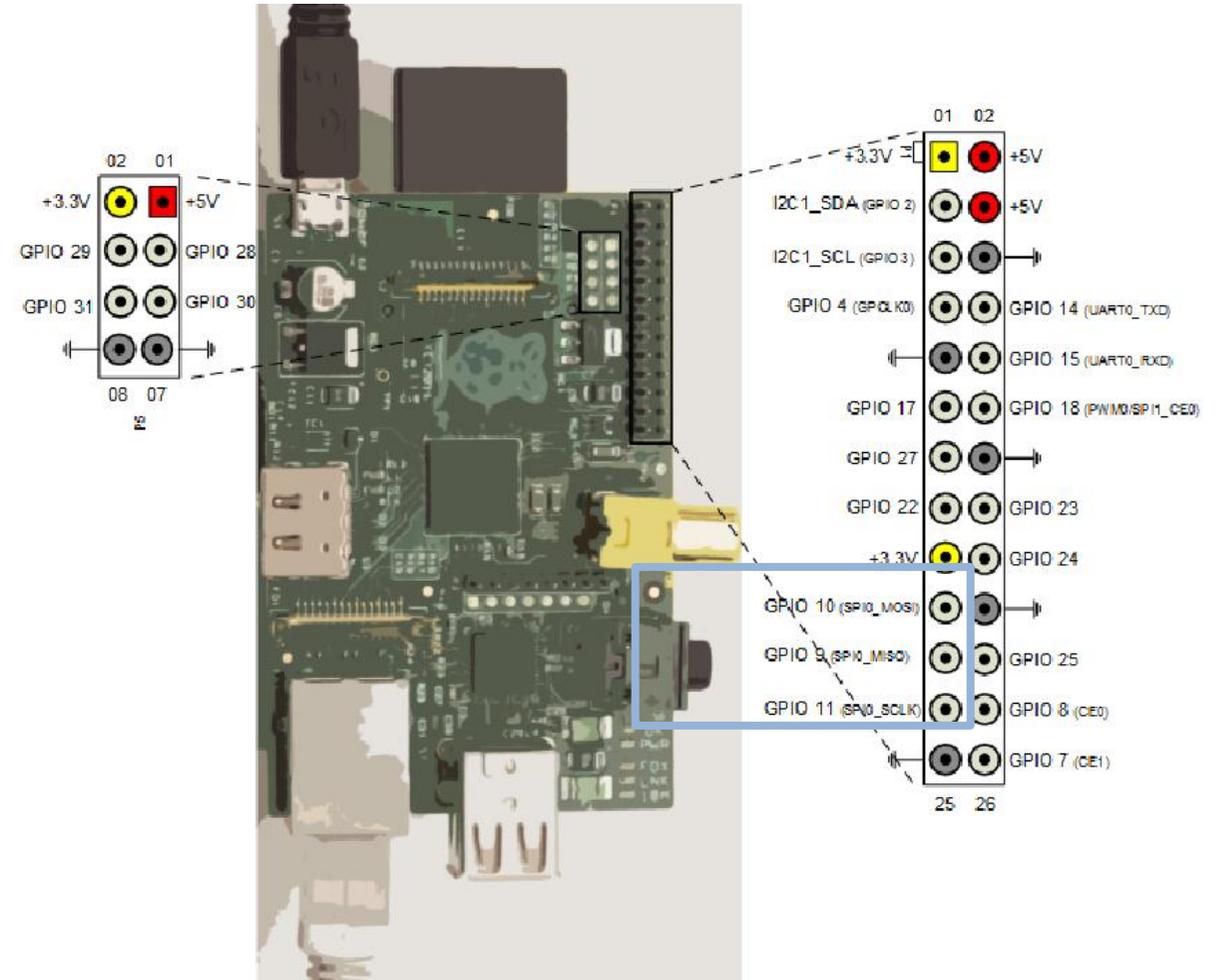
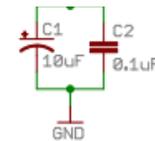
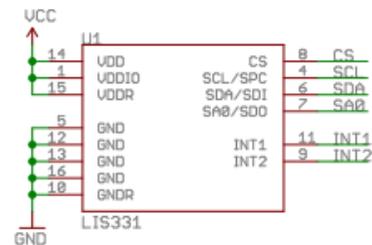
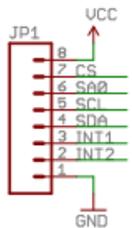


# Connecting an SPI sensor

We need to connect:

- SDA to GPIO 10 (SPI0\_MOSI)
- SA0 to GPIO 9 (SPI0\_MISO)
- SCL to GPIO 11 (SPI0\_CLK)
- CS to GPIO 8 (CEO)
- VCC to **3.3V**
- GND to GND

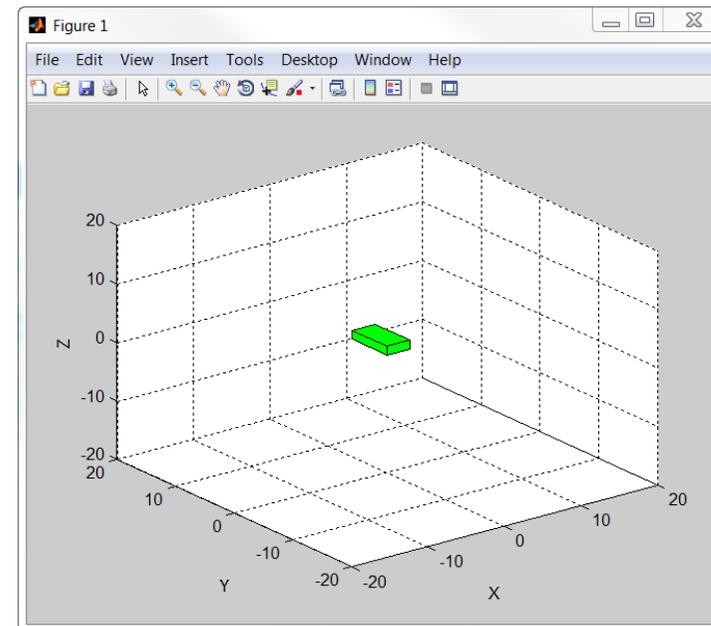
Sensor pinout for LIS331 accelerometer



# Summary : Reading from LIS331 3- axis accelerometer

- Create raspi object
- Enable SPI
- Create Acceleration Sensor object
  - Object decodes
  - Object maps registers
- Take readings
- Do something interesting
  - Simple Orientation Sensor

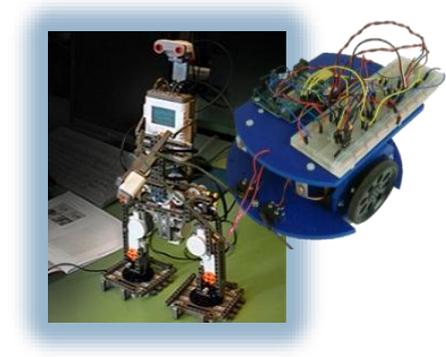
```
mypi = raspi;  
enableSPI(mypi);  
ac = lis331(mypi, 'CE0'); % create sensor object  
[x,y,z]=ac.readAcceleration;
```



## Wrap-Up

- How to install Raspberry Pi MATLAB Support
- How to acquire images using Camera Board
- How to use I2C and SPI sensors from MATLAB with your Raspberry Pi
- Application examples
  - Face Detection
  - Plotting temperature
  - Orientation sensing

# How to buy MATLAB and Simulink



## Standard

For use at a commercial, government, or other organization by a single user.

## Education

For use in teaching and academic research at a degree-granting institution.

## Student

For use in conjunction with courses offered at a degree-granting institution.

## Home

For personal use only. Not for government, academic, commercial, or other organizational use.

More information at:

<https://www.mathworks.com/store/index.do>

# Get started today!

- Get your Raspberry Pi
  - [www.element14.com](http://www.element14.com)
- Install MATLAB & Simulink
  - <https://www.mathworks.com/store/index.do>
- Get the Raspberry Pi support package
  - <http://www.mathworks.com/hardware-support/raspberry-pi-matlab.html>
- Visit MakerZone other project ideas
  - [www.makerzone.mathworks.com](http://www.makerzone.mathworks.com)



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