Bonus
EV3 Programming
Lessons

LEGO MINDSTORMS and Raspberry Pi IR Light controller

By Droids Robotics

Objectives

- Program a Raspberry Pi to control a string of LED lights using an IR sensor
- Learn how to make the EV3 communicate with a Raspberry Pi
- Learn to use an IR sensor and IR LED to emulate remote signals

- **Prerequisites:**
  - *Must have basic Python programming knowledge*
  - *Must be comfortable using a Raspberry Pi (Unix/Linux commands & GPIO)*
  - *Must be familiar with EV3 Bluetooth Messaging*
  - *Must have done EV3 Raspberry PI Communicator lesson on EV3Lessons.com*

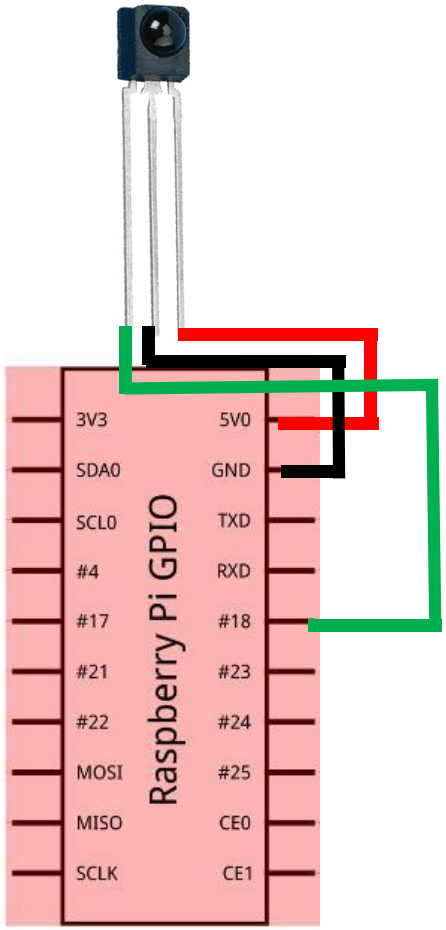
Materials

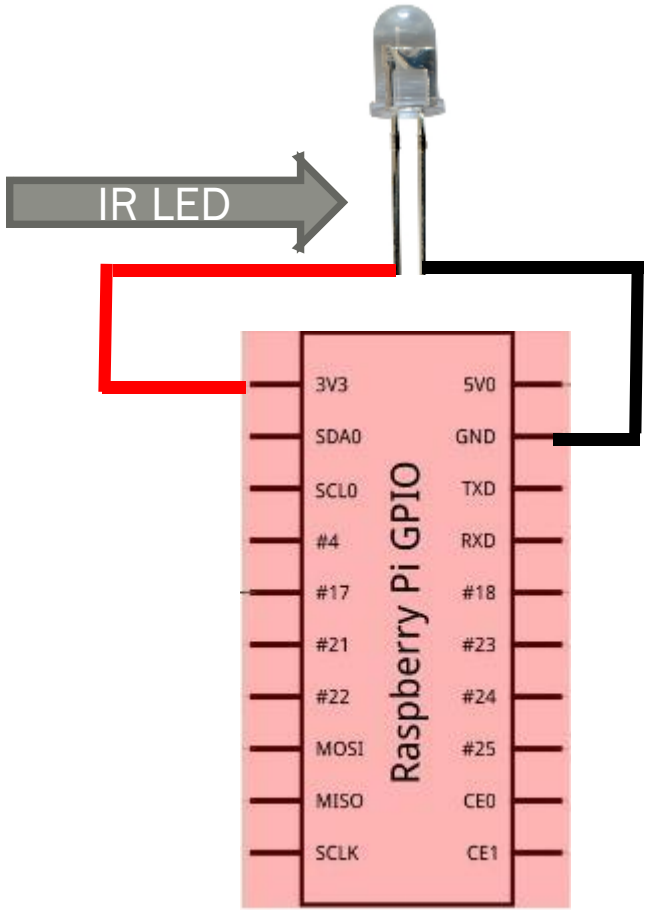
- Raspberry Pi (Tested on Model B Edition 1 using Raspbian)
- EV3 brick
- USB Bluetooth (for the Raspberry Pi)
- IR Sensor (for the Raspberry Pi)
- IR LED (for the Raspberry Pi)
- LED Strip with IR receiver and remote
  - *E.g. Intertek flexible lighting strips*
- GPIO compatible wires (for Raspberry Pi)
- Breadboard (optional)

Step 1: Pi Setup

- Setup the IR sensor and IR LED on the GPIO (see next slide).
  - *Make sure you arrange the wires correctly based on the sensor you own. (You can use a volt meter to arrange the wires correctly – to identify ground, voltage and ground)*
- Install packages on the Raspberry Pi
  - `sudo apt-get update`
  - `sudo apt-get upgrade`
  - `sudo reboot`
  - `sudo apt-get install lirc`
  - Make sure you have completed all the steps in the EV3-RPi Communicator Lesson

GPIO Setup





Configuration based on IR sensor available on Adafruit (Product link)

Step 2: Edit System Files

- `sudo nano/etc/modules`
- *add these lines at the end to make LIRC start up on boot and set the IR sensor pin to Pin-18 and IR LED pin(for later) to Pin-17:*
- *`lirc_dev`*
- *`lirc_rpi gpio_in_pin=18 gpio_out_pin=17`*

- Now we need to edit the LIRC hardware configuration file. Open it using: sudo nano /etc/lirc/hardware.conf
- *Change the following lines:*
- *`DRIVER="default"`*
- *`DEVICE="/dev/lirc0"`*
- *`MODULES="lirc_rpi"`*
- `sudo nano /boot/config.txt`
- *add the following line to the file:*
- *`dtoverlay=lirc-rpi,gpio_in_pin=18,gpio_out_pin=17,gpio_in_pull=up`*
- Reboot: `sudo reboot`

Step 3: Record All Remote Buttons

- Stop LIRC: *sudo /etc/init.d/lirc stop*
- To make sure you setup the IR sensor correctly, use: *mode2 -d /dev/lirc0* (press buttons on a remote to get the readings)
- Record all the buttons to the raspberry pi: *irrecord -n -d /dev/lirc0 ~/lircd.conf* -- It will take you through some detailed instructions.
- sudo nano lircd.conf Find the line that says "*name /home/pi/lircd.conf*" and change it to "name remote"
- Copy the new configuration -- *sudo cp lircd.conf /etc/lirc/lircd.conf*
- Start LIRC: *sudo /etc/init.d/lirc start*
- Reboot: sudo reboot
- To test the configuration run the commmand *irw*
  - *Every time you press a button on the remote, you will get the name of the button.*

Step 4: Send IR signals with Pi

- Connect the IR Led to the GPIO (See image on right)
- To send an IR signal use
  - `irsend SEND_ONCE remote ONE_OF_THE_BUTTONS_NAME`
  - *We use `SEND_ONCE` to only sent the light signal once*
- Now in python you can send a signal using
  - `import os`
  - `os.system("irsend SEND_ONCE remote ONE_OF_THE_BUTTONS_NAME")`
  - Replace `ONE_OF_THE_BUTTONS_NAME` with one of the names you assigned to a button in step 3
- In a terminal you can use
  - `irsend SEND_ONCE remote ONE_OF_THE_BUTTONS_NAME`

Step 5: Bluetooth EV3 to Pi (If you are not already connected)

- Run *hcitool* scan to find the mac address of EV3 (will look something like this: 00:16:53:3F:2F:C3)
- Run *bluetooth-agent 1234 &* :proxy for entering passcode for ev3
- Run *sudo rfcomm connect /dev/rfcomm0 MAC_ADDRESS &* :to connect the ev3 (press enter if any message(s) appears on the screen)
- If you are not returned to a terminal, try pressing “Return/Enter”. If that did not work you probably forgot the *&* symbol.

Step 6: Base Code

- *Open RPi code you made in the* EV3-RPi Communicator Lesson
- *Open EV3 code you made in the* EV3-RPi Communicator Lesson

Challenge 1: Change the LED's Color Using the EV3

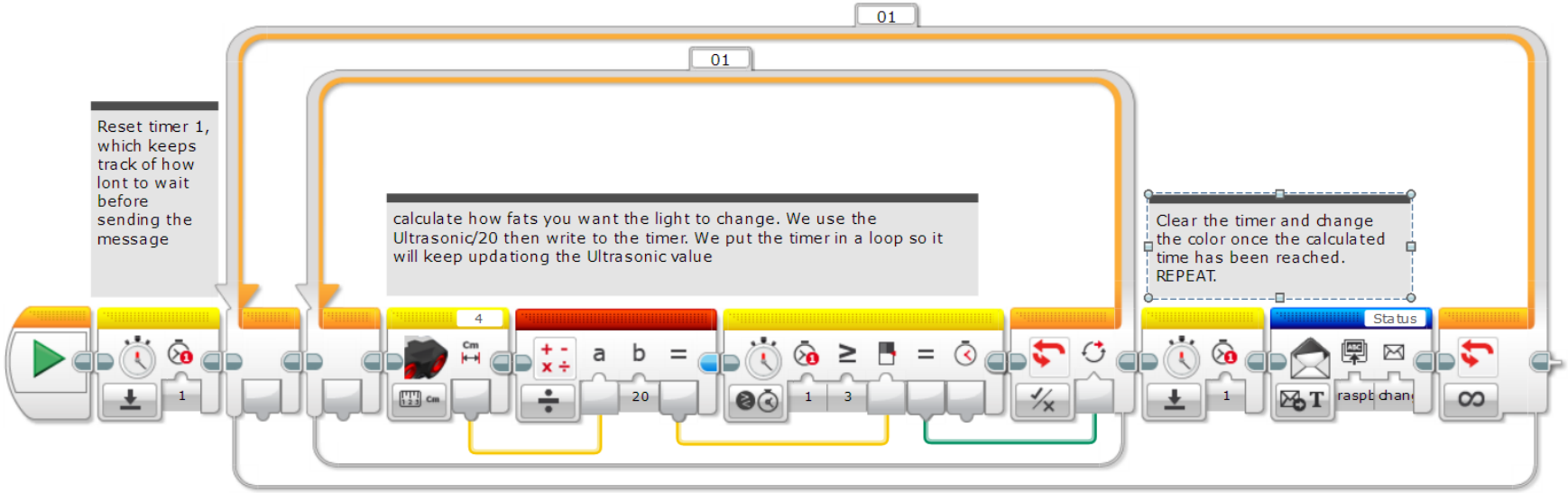
- Make the LED strip change color/change mode when the EV3 sends "color_change"
- *You will need to use* `os.system("irsend SEND_ONCE remote ONE_OF_THE_BUTTONS_NAME")` in python

- *Download solution code from EV3Lessons.com*

Challenge 2: Change the LED's Colors At Different Rates Using the Ultrasonic Sensor

- Make the LED strip change color/change mode when the EV3 sends "color_change"
- *Download solution code from EV3Lessons.com*

Challenge 2 Solution



CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan from Droids Robotics.
- More lessons are available at www.ev3lessons.com
- Author's Email: team@droidsrobotics.org
- Credits: Antzy Carmasaic for the IR remote recoder & gipprojects for the code to connect a Raspberry Pi to an EV3