CamJam EduKit Sensors Worksheet Four

Project Light Sensor

Description In this project, you will learn how to detect how bright it is in your room.

NOTE: This worksheet can use a Raspberry Pi Model A, B or B+. The first 26 pins on the B+ (when looking at the Pi with the pins in the top left) are exactly the same as the Model A and Model B.

Equipment Required

□ Raspberry Pi & SD card

□ Keyboard & Mouse

□ Monitor & HDMI Cable

□ Power supply

□ 400 Point Breadboard

□ 3 x m/f jumper wires

□ 3 x m/m jumper wire

□ LDR - Light Dependent Resistor

□ 1uf Capacitor

The Parts

Two parts you will use may not be familiar to you.

Light Dependent Resistor

A Light Dependent Resistor – or LDR – is a resistor whose resistance changes depending on how much light is falling on its surface.

It will not accurately measure the light, but just measures the change in light falling on the sensor. For example, it could be used to see whether it is light or dark in a room.

Capacitor

A capacitor is an electronic device that stores electric energy. It is similar to a battery, but is smaller, lightweight and charges up much quicker.

Capacitors are usually made with two metal plates that are on top of each other and near each other, but that do not actually touch. When powered, they allow energy to be stored inside an electrical field. Because the plates need a lot of area to store even a small amount of charge, the plates are usually rolled up into some other shape, such as a cylinder.

The capacity of a capacitor is measured in Farads. Because a Farad is a large number, capacitors are often labelled in micro (µ) Farads, or µF.

As with batteries, there is a negative and a positive leg. The negative leg is the one that is usually marked – in this case with a white bar.

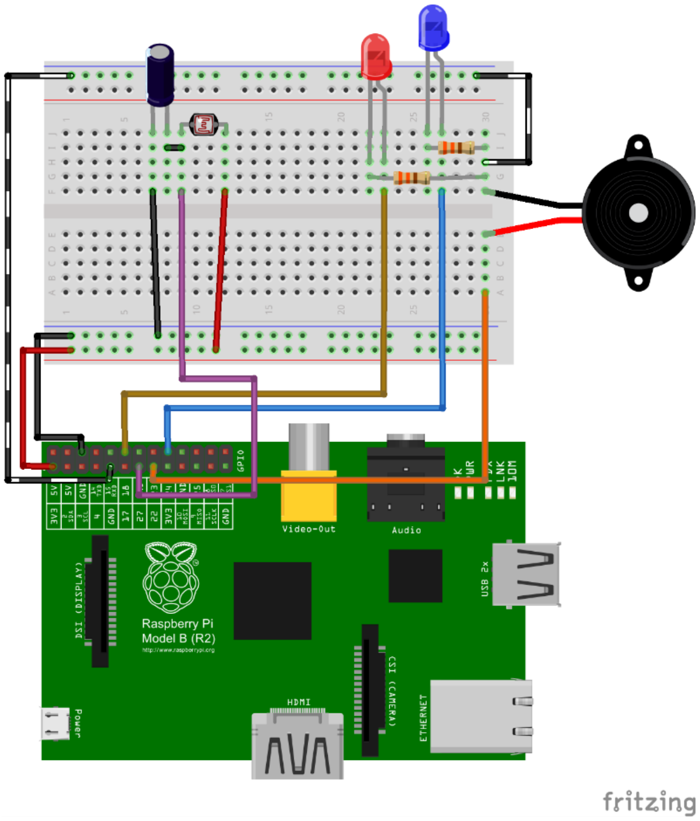
In this circuit it is being used as a way to convert an analogue signal (the resistance of the LDR) by timing how long it takes to charge the capacitor, which will depend on how much energy is supplied to

The Parts

the capacitor, and in turn that is limited by the resistance the LDR gives to the flow of energy in the circuit.

Building the Circuit

Turn the Raspberry Pi off before building this circuit.



Build the circuit as shown in the diagram on the left, leaving the buzzer and LED circuit in place.

The left leg of the capacitor in the diagram is the negative leg, marked by the white bar. The negative leg of the capacitor is connected to ‘ground’ on the Pi, and the positive leg is connected to the 3.3v of the Pi via the LDR.

The resistance of the LDR will affect how quickly the capacitor will charge up, which is read by Pin 27 of the Raspberry Pi. The higher the resistance, the longer it takes to charge.

Note the wire between the positive leg of the capacitor and the LDR. This is a jumper with a pin at each end.

Code

Create the code with the following instructions:

1. Change directory to the directory we created in Worksheet One using:
   ```
   cd ~/EduKitSensors/
   ```
2. Create a new text file “4-LDR.py” by typing the following:
   ```
   nano 4-LDR.py
   ```
3. Type in the following code:
   ```
   # Import Libraries
   import time
   import RPi.GPIO as GPIO
   ```

Code

```
# Set the GPIO Mode
GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)

# A variable with the LDR reading pin number
PINLDR = 27

def ReadLDR():
  LDRCount = 0 # Sets the count to 0
  GPIO.setup(PINLDR, GPIO.OUT)
  GPIO.output(PINLDR, GPIO.LOW)
  time.sleep(0.1) # Drains all charge from the capacitor

  GPIO.setup(PINLDR, GPIO.IN) # Sets the pin to be input
  # While the input pin reads ‘off’ or Low, count
  while (GPIO.input(PINLDR) == GPIO.LOW):
    LDRCount += 1 # Add one to the counter
  return LDRCount

while True:
  print ReadLDR()
  time.sleep(1) # Wait for a second
```

Once complete use “Ctrl + x” then “y” then “enter” to save the file.

Running the Code

To run this code type:

```
sudo python 4-LDR.py
```

Change the light intensity by covering up the LDR, or shining a light at the LDR. Watch the readings change.

How the Circuit Works

So, how does the circuit measure how much light is falling on the LDR?

When the function `ReadLDR` is called, the measurement pin (`PINLDR`) is first set to be an output pin and is set to ‘low’, or 0 volts, for a short time. This will empty the capacitor of charge.

The measurement pin will then be set as an input pin, which will then detect the voltage across the capacitor. Because the Raspberry Pi GPIO input is digital only, it only knows when the input is either ‘off’ (0v) or on (3.3v). The Pi actually considers any voltage on an input pin that is between 0 and about 1.4v to be ‘off’ (or 0), and anything between 1.4v and 3.3v to be ‘on’.

As the capacitor charges up, the Pi is able to time how long it takes for the input pin to change from ‘off’ to ‘on’ by using a simple counter (`LDRCount`). `LDRCount` represents how much light is on the

How the Circuit Works

resistor. The more light, the lower the resistance the LDR provides, and therefore the quicker the capacitor charges and the lower the value of `LDRCount`.

LDRs are not accurate pieces of electronics. Each one will differ. Therefore, they cannot be used to accurately measure how bright the light falling on them is. In addition, if other programs are running on the Pi, the counter loop may run a little slower.

Challenge

Extend the code above to turn on the LEDs under chosen conditions. As mentioned above, each LDR measures light brightness differently, therefore you are free to choose what light level you turn the LEDs on and off.

- When the light falling on the LDR is bright enough, light the red LED.
- When it goes below a certain level, turn on the BLUE LED.
- If the light gets really bright, sound the buzzer.