

Device Interfacing with Python and ZIO

vijaykumar@zillogic.com
Zilogic Systems



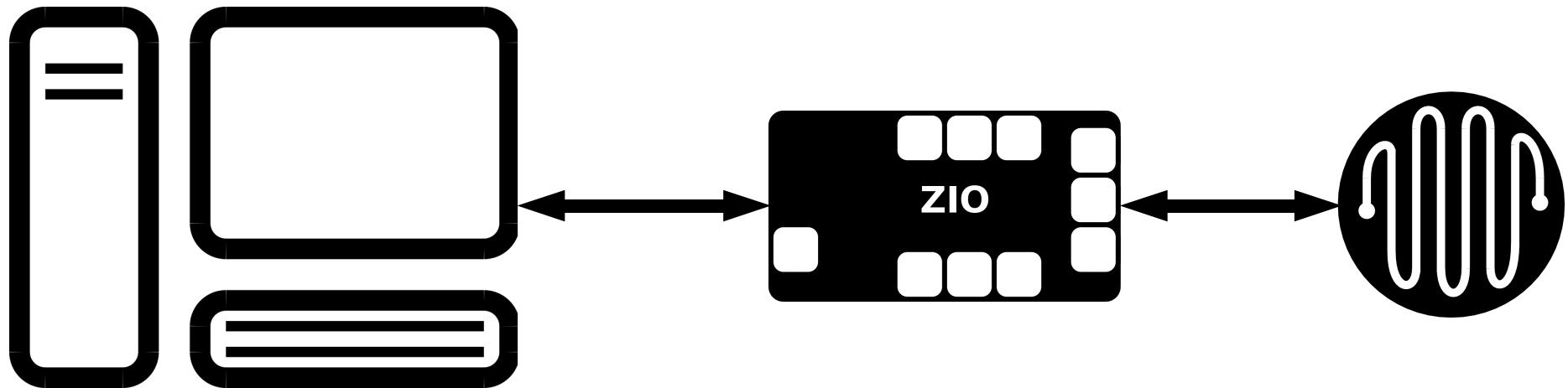
Overview

- Introduction to ZIO
- Interfacing Devices
- Demo Projects

Device Interfacing

- Parallel Port
- Limitations
 - Only Digital IO
 - Phased out

ZIO Architecture



PC – The Universal Platform
API to communicate with ZIO

USB based IO board

- Digital I/O
- Analog Input
- PWM Output
- I²C Bus
- SPI Bus

Sensors
Transistors
Relays
LEDs
Switches
I²C Devices
DC Motors
IR receivers
...

ZIO Agent

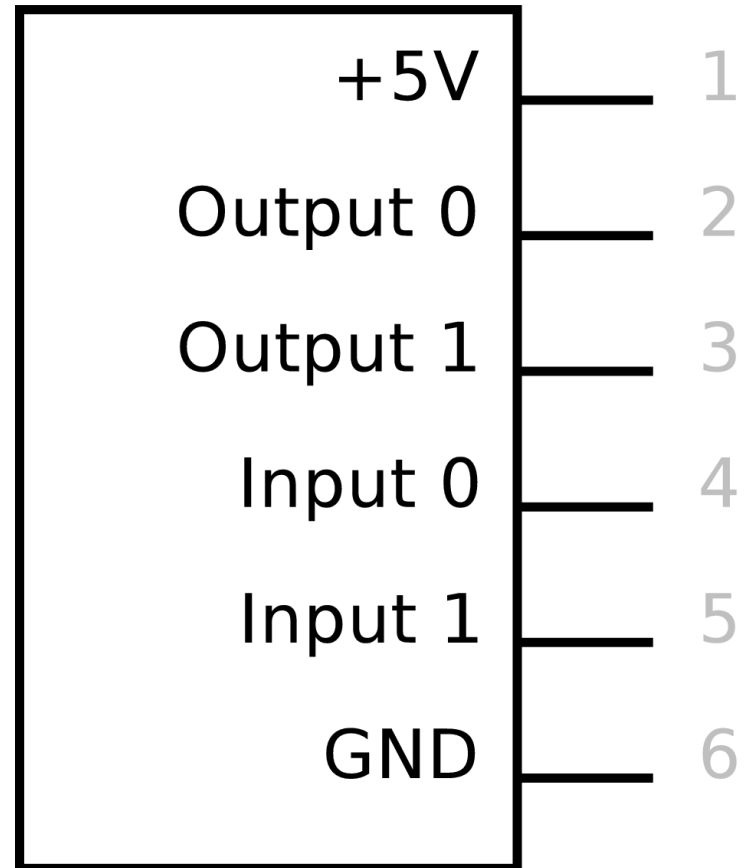
- ZIO Motherboard is powered by a ARM processor.
- ZIO Agent
 - Receives commands from PC through USB
 - Manipulates the interfaces based on the commands

Ports

- GPIO
 - LEDs, Relays, Switches, MOSFETs, Optocouplers, ...
- Sensor
 - Temperature, Potentiometer, Light, Pressure, Humidity, ...
- PWM
 - DC Motor, Servo Motor, LED Brightness Control, ...
- I2C/SPI
 - RTCs, LCDs, IR Receivers, Sensors, Phone Line Interface
 - ...

Ports (Contd.)

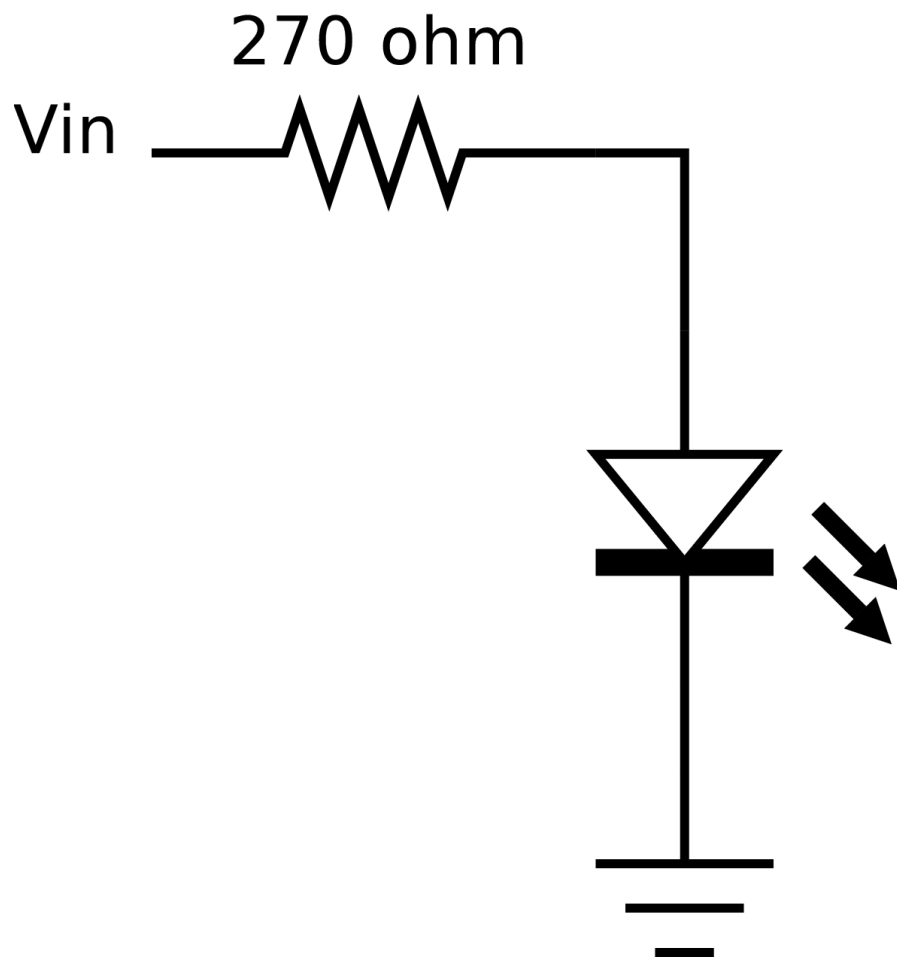
- Each Port has 6 signals
- Example GPIO port
 - +5V Power
 - GND
 - 2 Outputs
 - 2 Inputs
- Terminated in RJ12 connector



Demo Board

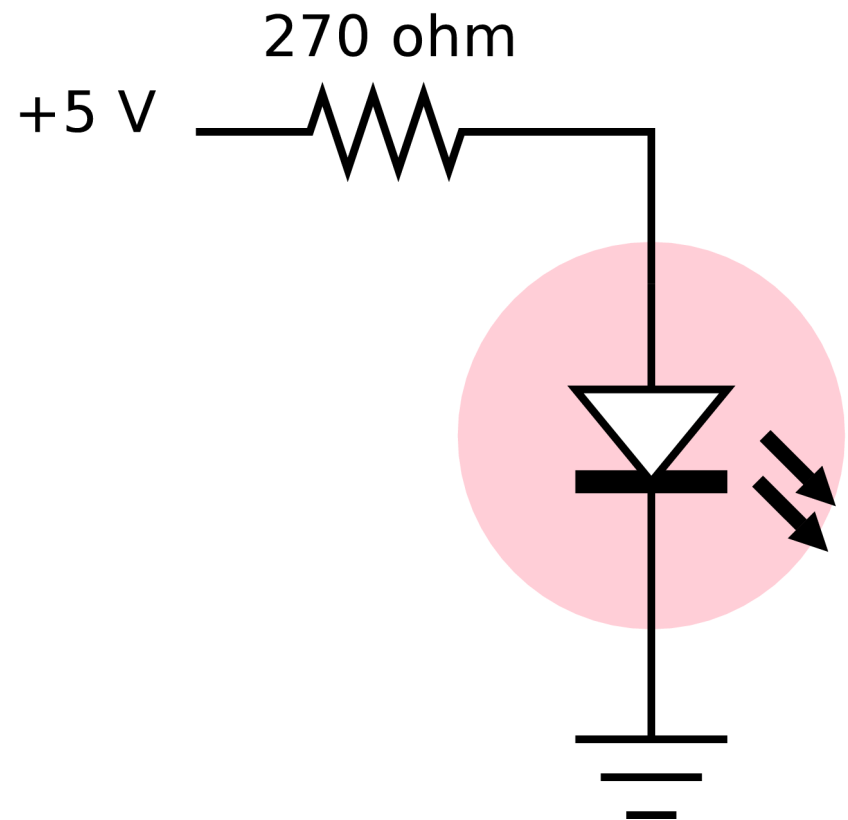
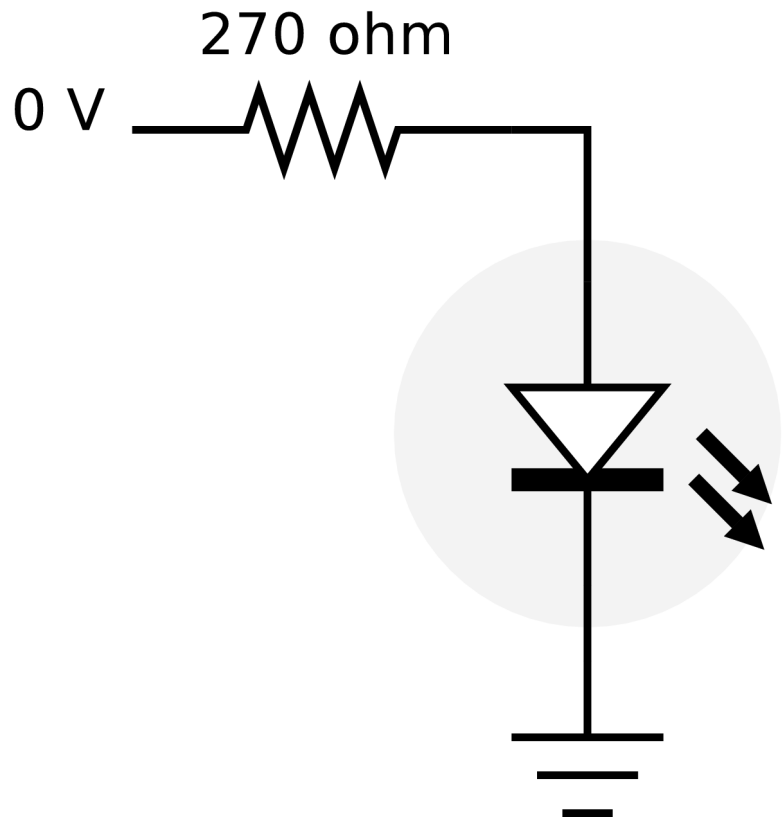
- ZIO Motherboard
- Bread Board
- RJ12 Breakout Board
- Devices Board
- Temp. Sensor Board

LED

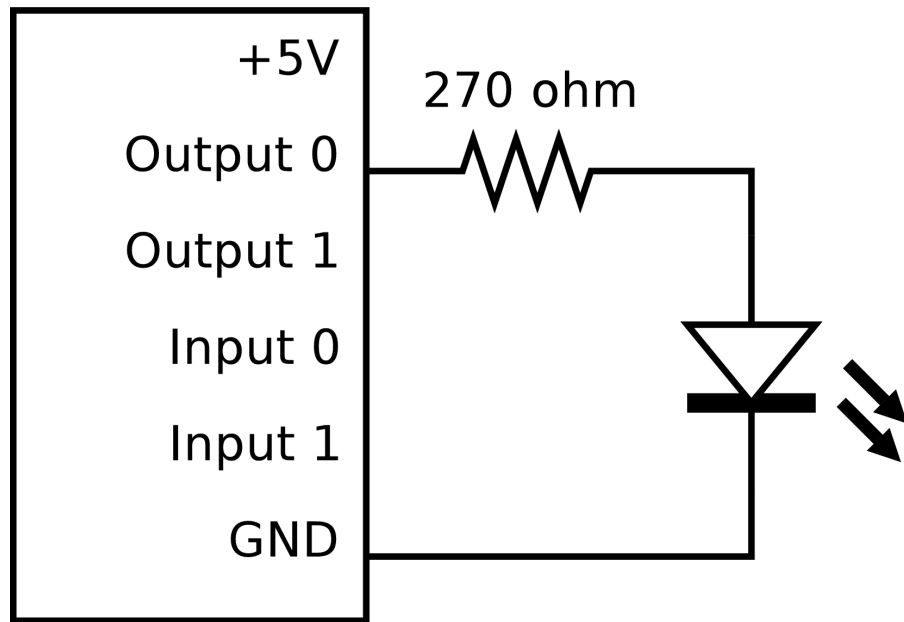


- Simple output devices
- Used for status indication, displays, lighting ...

LED (Contd.)

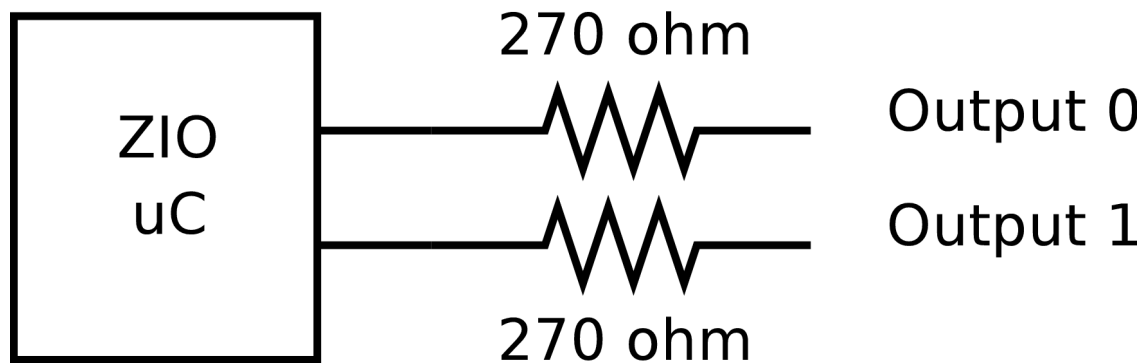


Interface LED to ZIO



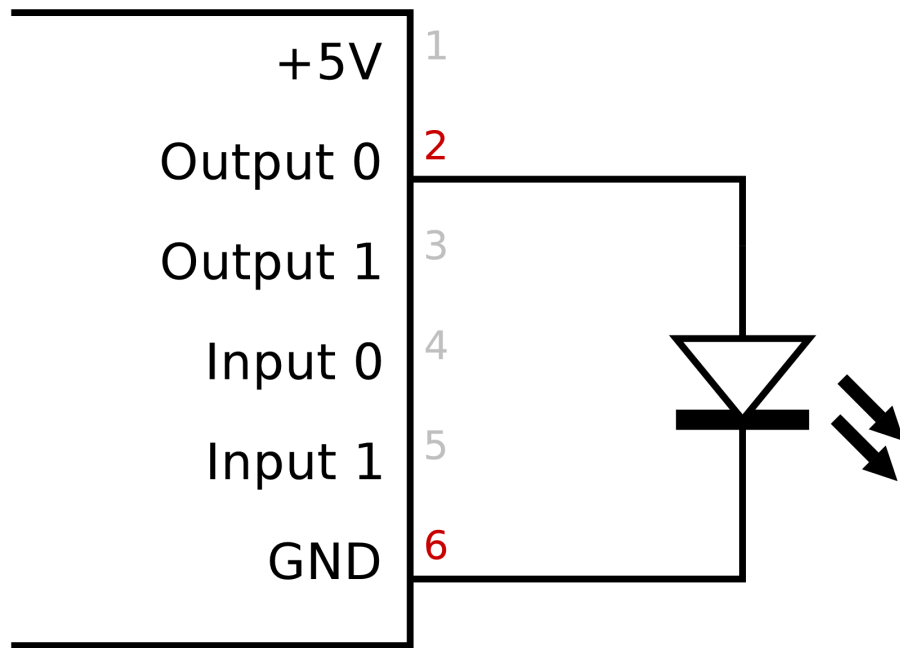
- GPIO Port
- Signals
 - 2 Outputs, 2 Inputs
 - +5V Supply, GND
- Setting Output to True, outputs 0V
- Setting Output to False, outputs 5V

Interface LED to ZIO (Contd.)



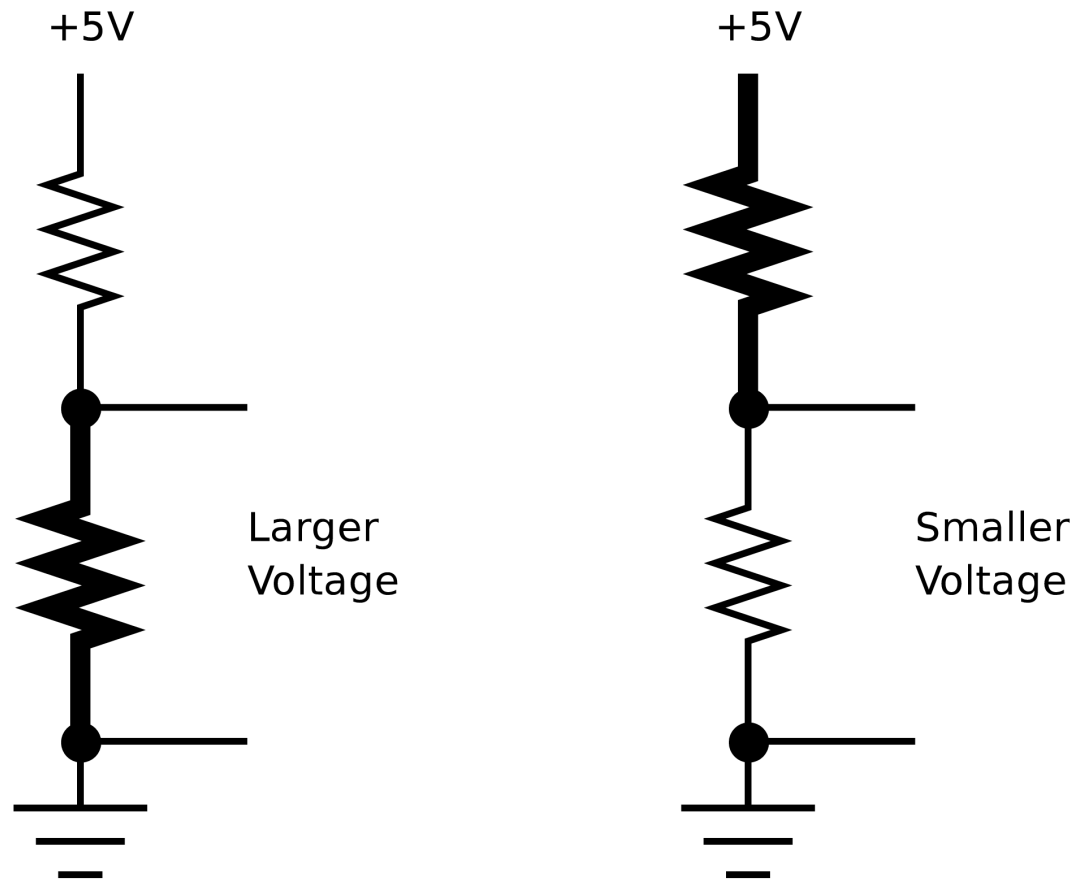
- GPIO outputs have a built-in series resistor
- Eliminates series resistors on external circuit

Interface LED to ZIO (Contd.)



```
from zio import *  
agent = Agent("/dev/ttyUSB0")  
gpio = GPIO(agent)  
gpio.write_output_pin(0, True)  
gpio.write_output_pin(0, False)
```

Voltage Divider

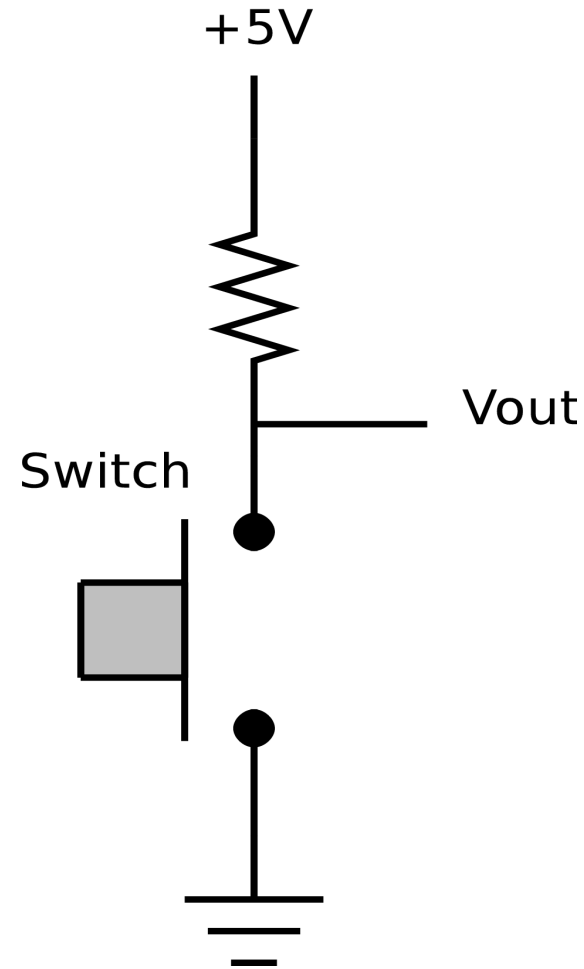


Larger the bottom Resistor
Larger the Voltage

Smaller the bottom Resistor
Smaller the Voltage

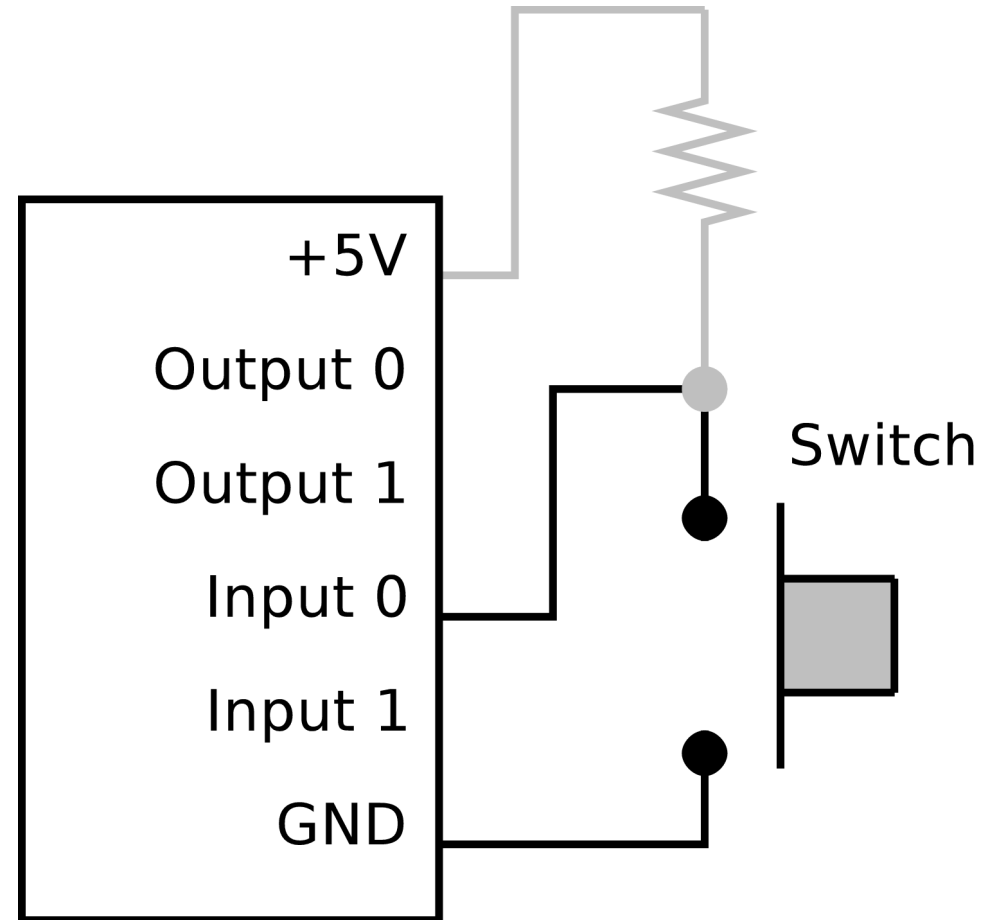
Switch

- Simple input device
- Switch is closed
 - $V_{out} = 0V$
- Switch is open
 - $V_{out} = 5V$
- Switch state can be determined, by measuring V_{out} .

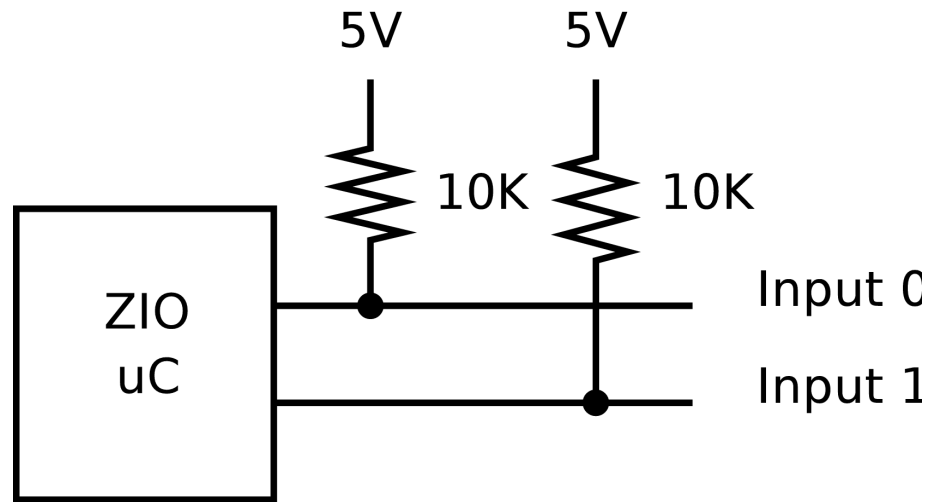


Interface Switch to ZIO

- GPIO Input signals can test for a 0V or 5V.
- Input $> 2V$
 - Read as True
- Input $< 0.8V$
 - Read as False

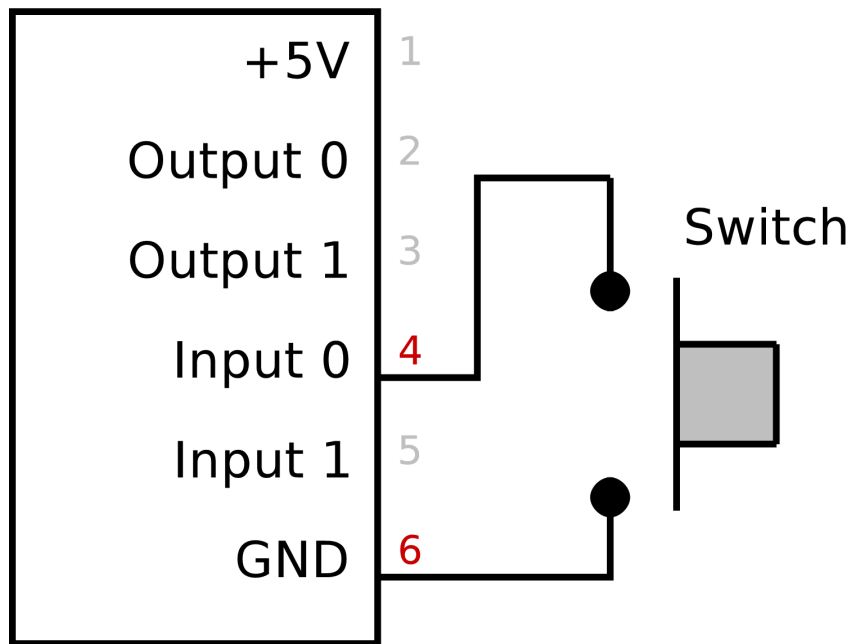


Interface Switch to ZIO (Contd.)



- GPIO inputs have built-in pull-ups resistors
- Eliminates pull-ups on external circuits

Interface Switch to ZIO (Contd.)

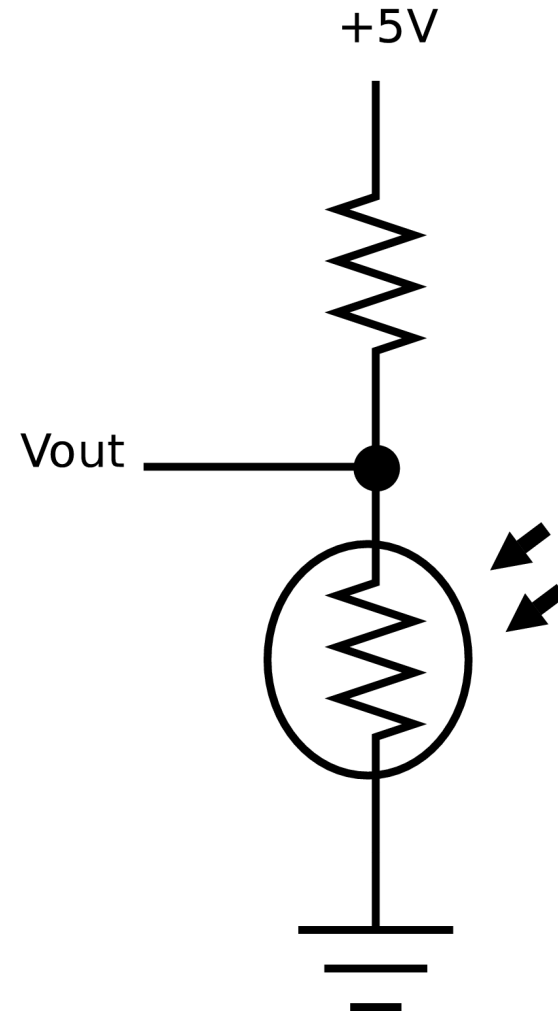


```
import time
from zio import *

agent = Agent("/dev/ttyUSB0")
gpio = GPIO(agent)
while True:
    print gpio.read_input_pin(0)
    time.sleep(1)
```

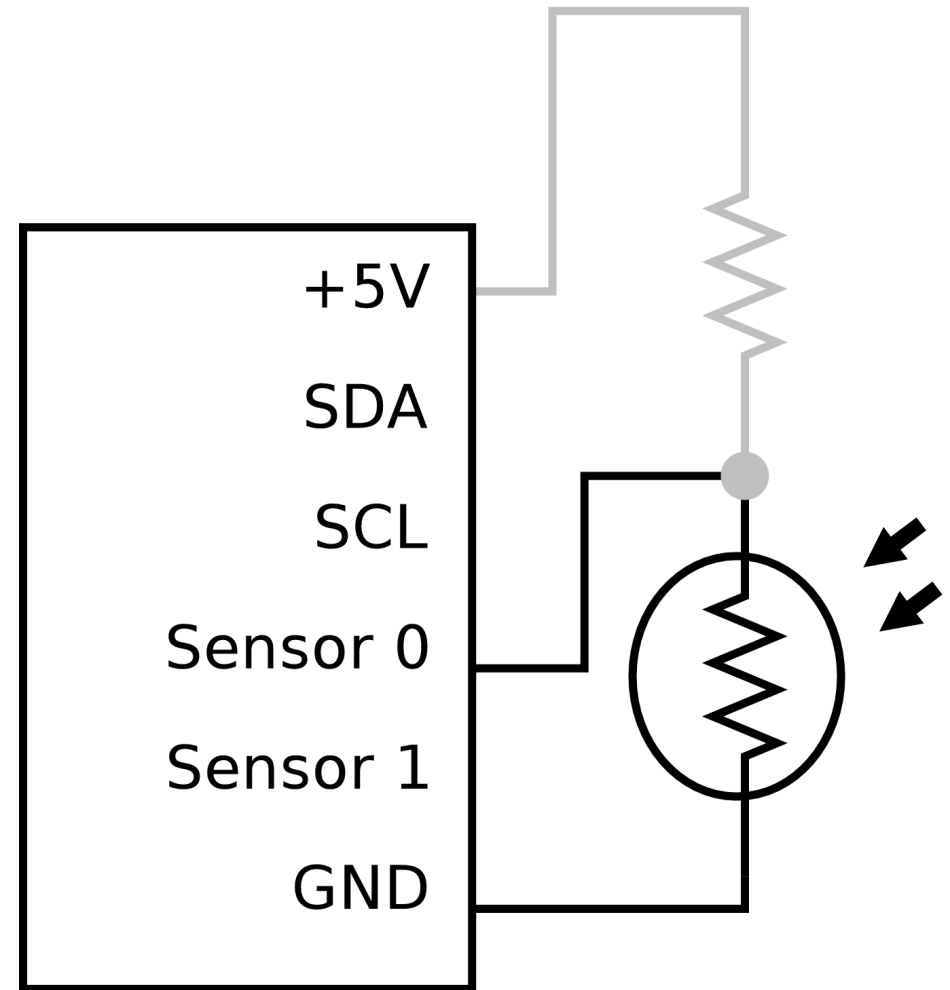
Light Sensor (LDR)

- LDR – Light Dependent Resistor
- Resistance decreases with increase in light intensity
- Voltage V_{out} decreases with increase in light intensity

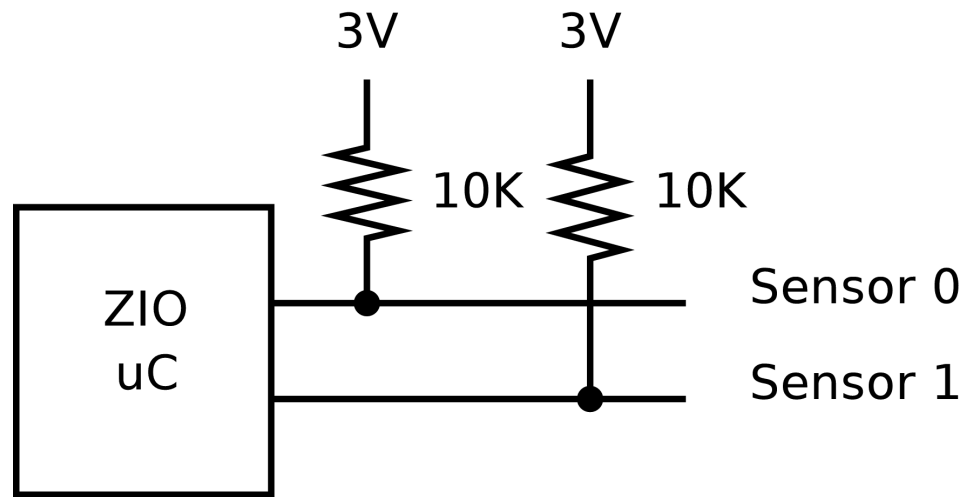


Interface LDR to ZIO

- Sensor port
 - measure voltages between 0 – 3V
- Signals
 - +5V, GND
 - 2 Sensor Inputs
- Read the voltage at Sensor 0

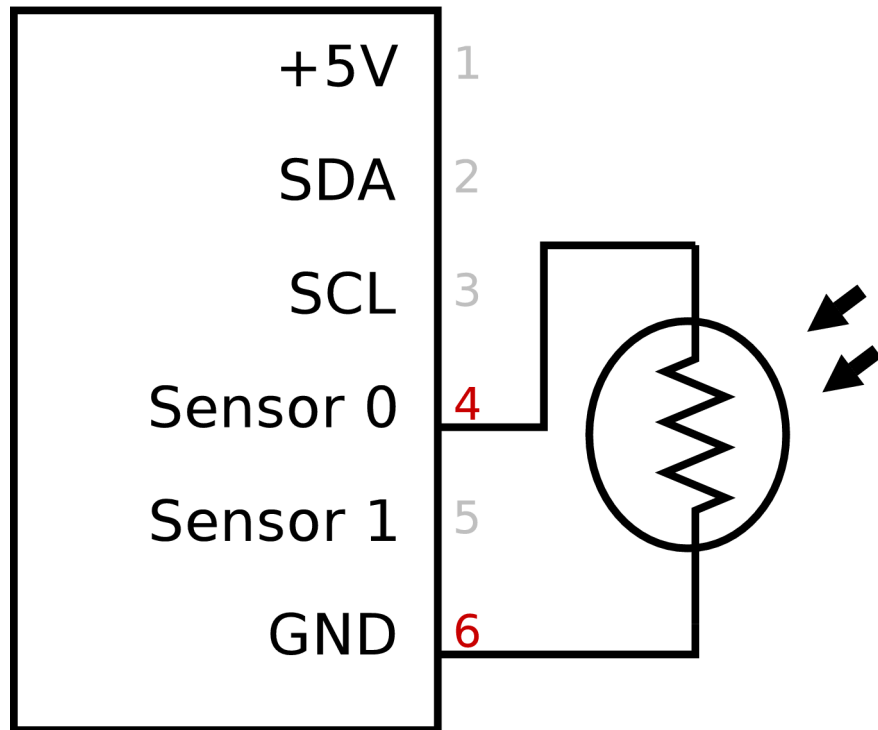


Interface LDR to ZIO (Contd.)



- Sensor inputs have built-in pull-up resistors
- Eliminates pull-ups on external circuits
- Pull-ups connected to 3V, the max voltage that can be measured by sensor port.

Interface LDR to ZIO (Contd.)

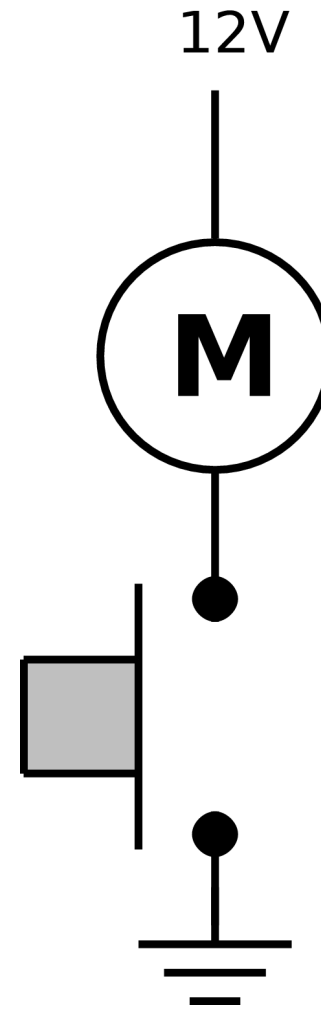


```
import time
from zio import *

agent = Agent("/dev/ttyUSB0")
sensor = Sensor(agent)
while True:
    print sensor.read_pin(0)
    time.sleep(1)
```

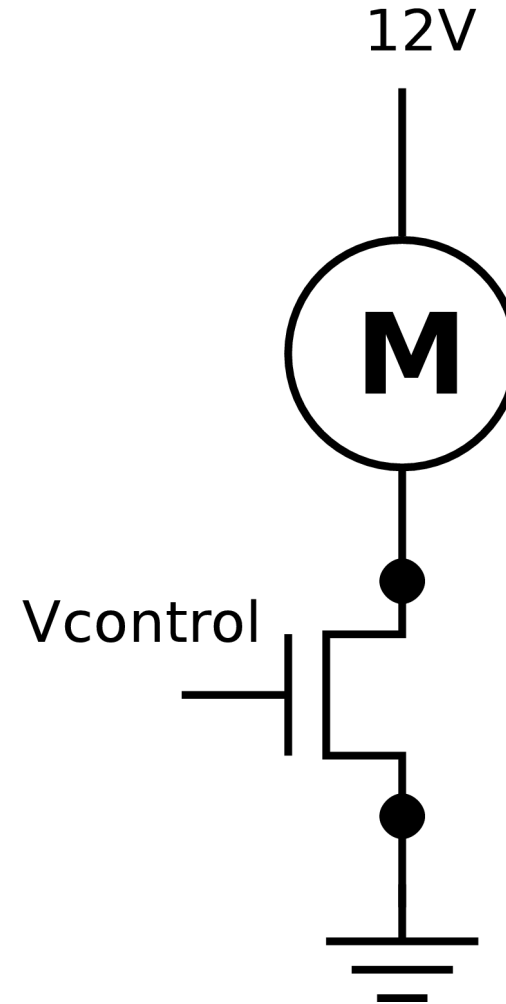
DC Motor

- Examples
 - CPU Fan
 - Wheels of a Robot
 - CDROM drives
 - Printers
- DC motor controlled by a human operated switch



DC Motor (Contd.)

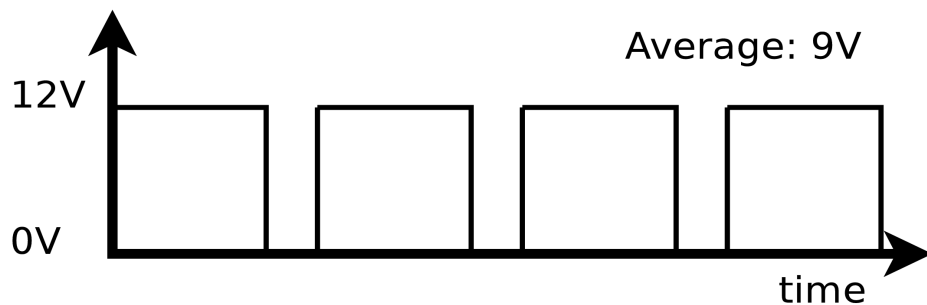
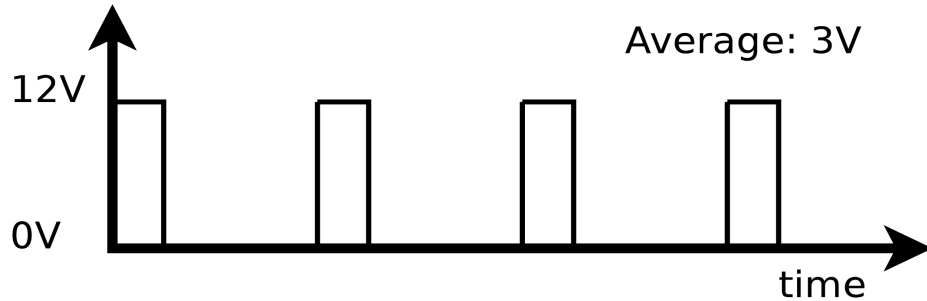
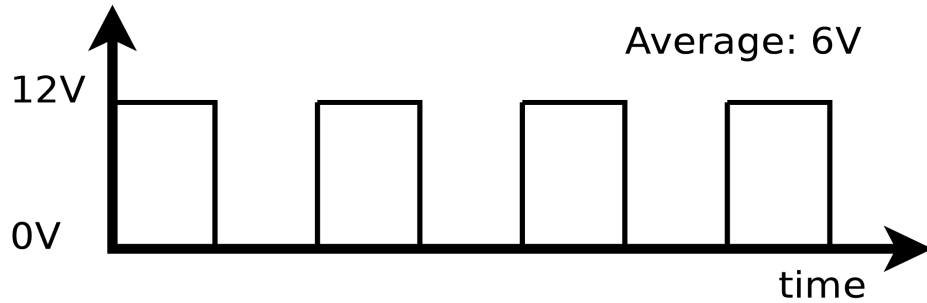
- Replace switch by a MOSFET
- $V_{\text{control}} = 5\text{V}$
 - Motor turns ON
- $V_{\text{control}} = 0\text{V}$
 - Motor turns OFF



DC Motor (Contd.)

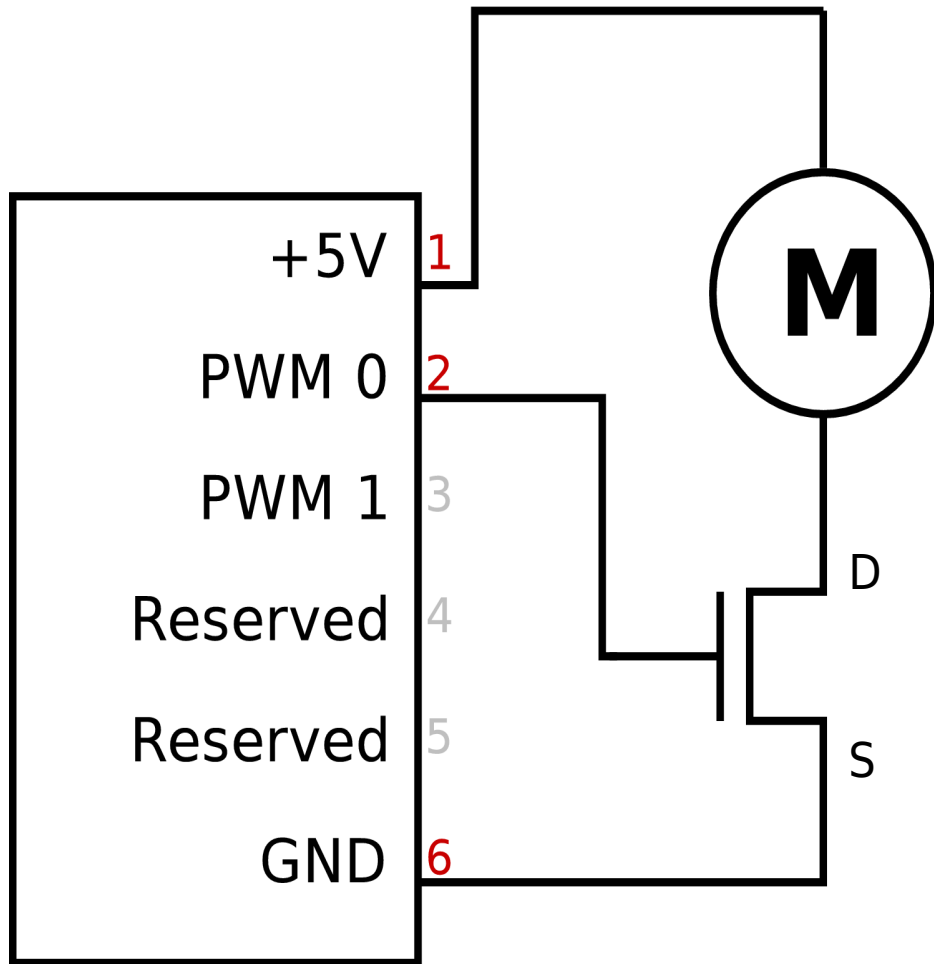
- GPIO port - motor ON and OFF
- Motor speed can be controlled
- DC motor speed is proportional to the supply voltage
- Speed control can be achieved by varying the averaging voltage delivered to the motor

DC Motor (Contd.)



- Rapidly turn motor on and off
- Duty cycle
 - $(\text{ON time} / \text{Period}) * 100$
- Duty cycle 100%
 - Average voltage - 12V
- Duty cycle 50%
 - Average voltage - 6V

Interface DC Motor to ZIO



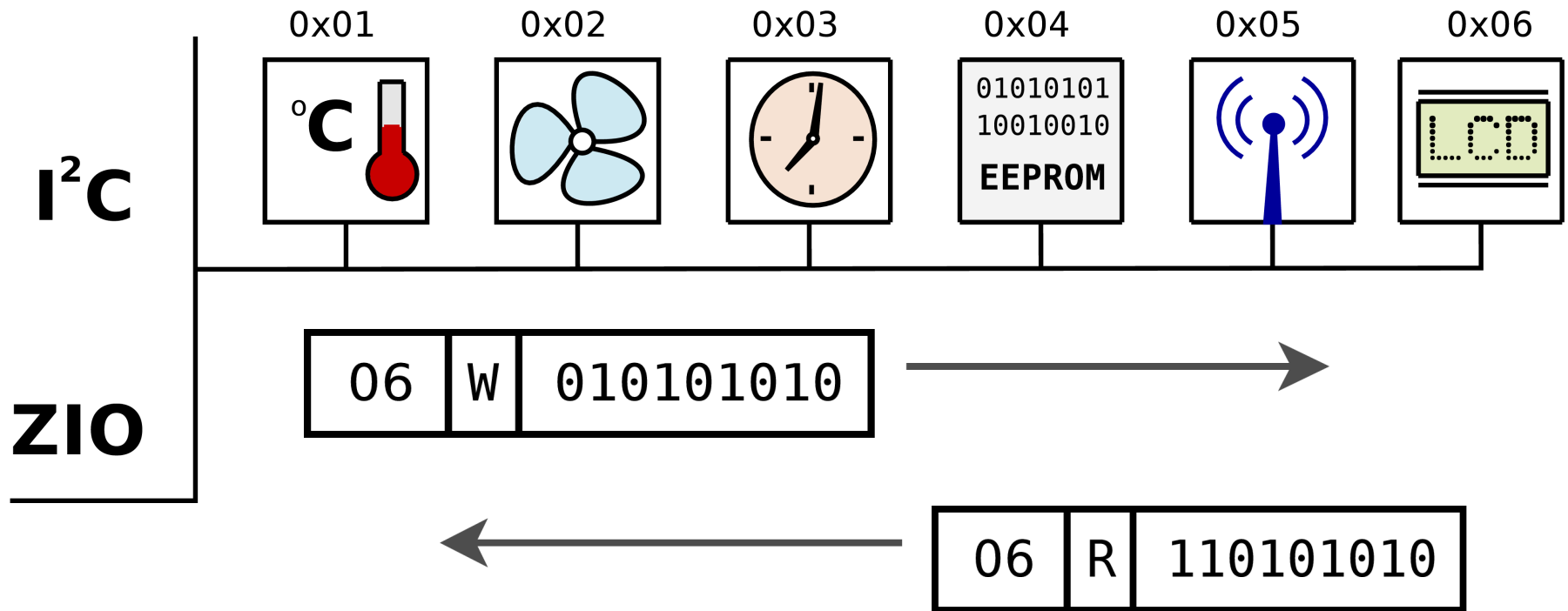
```
pwm = PWM(agent)
pwm.set_freq([0], 25)
pwm.set_duty([0], 100)
pwm.start([0])
```

```
pwm.set_duty([0], 50)
pwm.set_duty([0], 25)
```

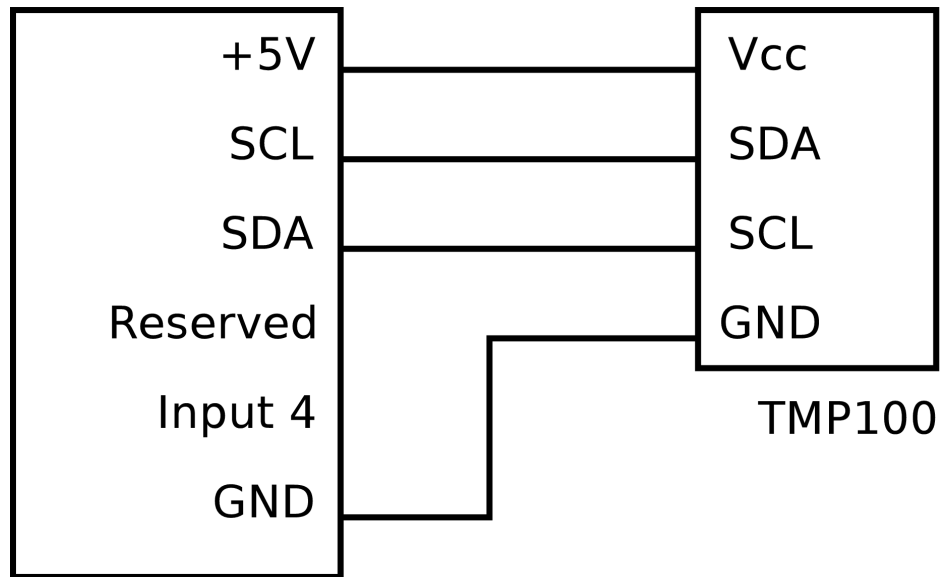
Temperature Sensor

- Temperature Sensors
 - Resistive Sensors
 - Non-ratiometric Sensors
 - I2C / SPI Sensors
- I2C
 - kind of very simplified USB
 - connect devices to CPU
 - EEPROMs, RTCs, Accelerometers, Sensors ...

I2C Bus



Temperature Sensor



```
i2c = I2C(agent)
i2c.config(100)
while True:
    temp = i2c.read(0x48, 1)
    print temp[0]
    time.sleep(1)
```

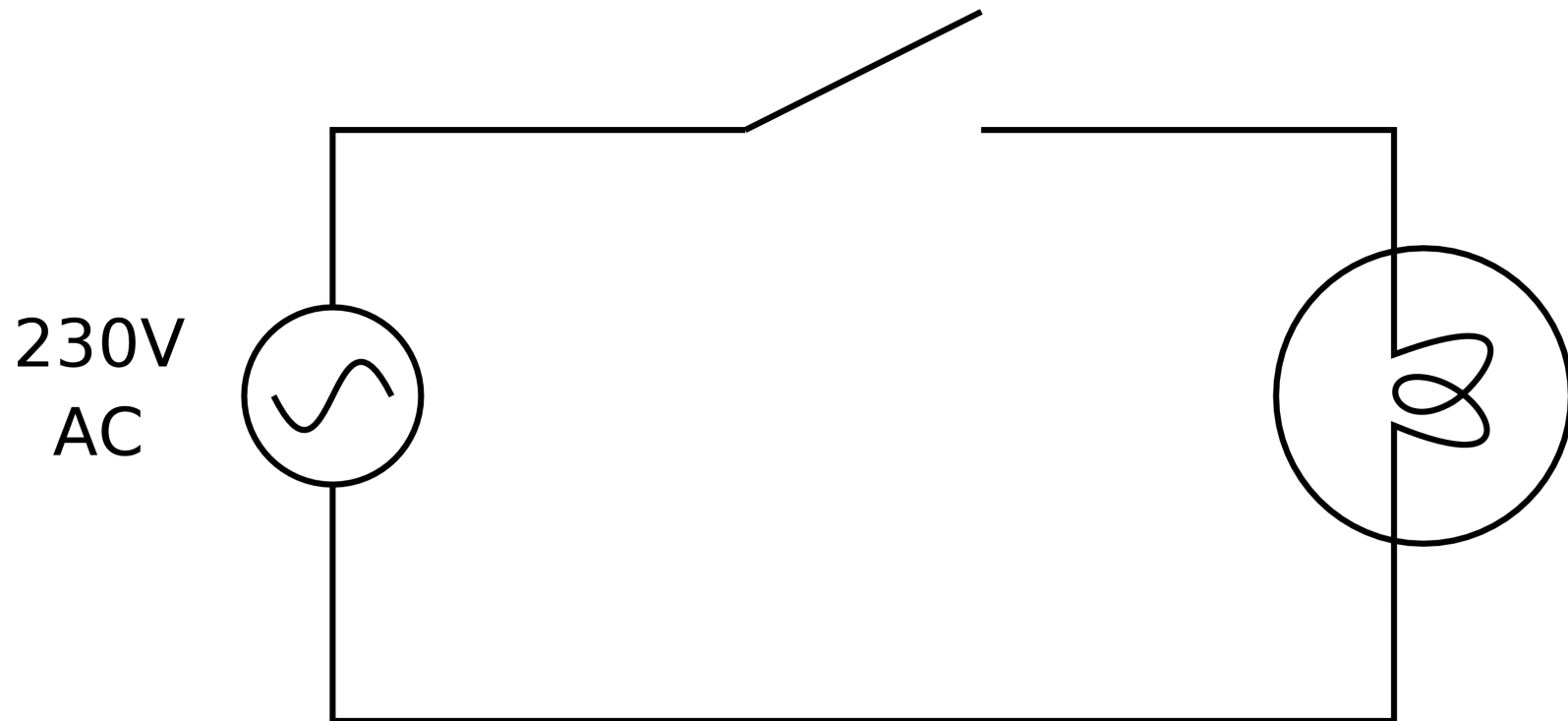
Demo Projects

- Laser Pointer Presentation Control
- Light Bulb Control

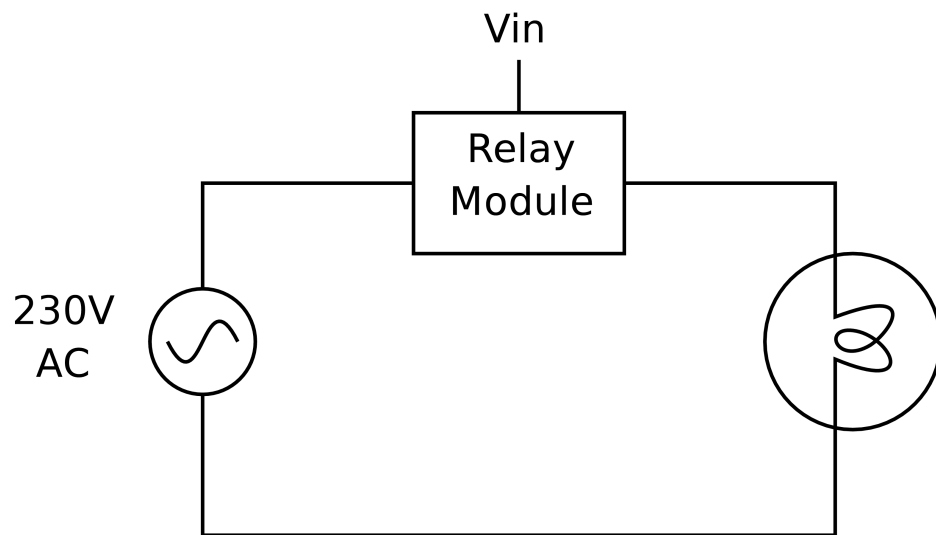
Laser Pointer Demo

- Control presentation with input from the laser pointer.
- ZIO + LDR + Laser Pointer + Software Magic
- User shines laser on the LDR
- Software detects drop in the input voltage
- Software generates a key (Space) to active window (the presentation)

Controlling a Light Bulb



Controlling a Light Bulb (Contd.)



- Relay is a mechanical switch controlled by an electro magnet
- If $V_{in} = 0V$ then bulb turns off
- If $V_{in} = 5V$ then bulb turns on

Questions

Credits

- Zilogic Team: Mr. PG and Mr. Kannan
 - Demo boards, Add-ons, Setup
- Software Tools
 - Dia
 - Open Office