Device Interfacing with Python and ZIO

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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
...

Zilogic Systems
• 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 ...

Zilogic Systems
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 ...

Vin ——— 270 ohm ——— LED
LED (Contd.)

![LED circuit diagrams](image)
Interface LED to ZIO

- GPIO Port
- Signals
  - 2 Outputs, 2 Inputs
  - +5V Supply, GND
- Setting Output to True, outputs 5V
- Setting Output to False, outputs 0V
Interface LED to ZIO (Contd.)

- GPIO outputs have a built-in series resistor
- Eliminates series resistors on external circuit
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
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 Vout 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
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.
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
- $V_{control} = 5\text{V}$
  - Motor turns ON
- $V_{control} = 0\text{V}$
  - 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
  - (ON time / 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

Ziologic Systems
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

230V AC
Controlling a Light Bulb (Contd.)

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

![Diagram of a light bulb circuit with a relay module](image)
Credits

• Behind the scenes Zilogic Team
  – PG  <pg AT zilogic DOT com>
  – Kannan <kannan AT zilogic DOT com>
  – Development of Demo boards, Add-ons, ...

• Software Tools
  – Dia
  – Open Office