Device Interfacing with Python and ZIO

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Zilologic 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 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 ...

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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.)

[Diagrams showing LED circuits with 270 ohm resistors and voltage applied or not applied.]
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
  - Vout = 0V
- Switch is open
  - Vout = 5V
- Switch state can be determined, by measuring Vout.
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

- Diagram showing the switch and GPIO connections.
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
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.
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
- $V_{control} = 5V$
  - Motor turns ON
- $V_{control} = 0V$
  - 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 ...
Temperature Sensor

```python
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 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