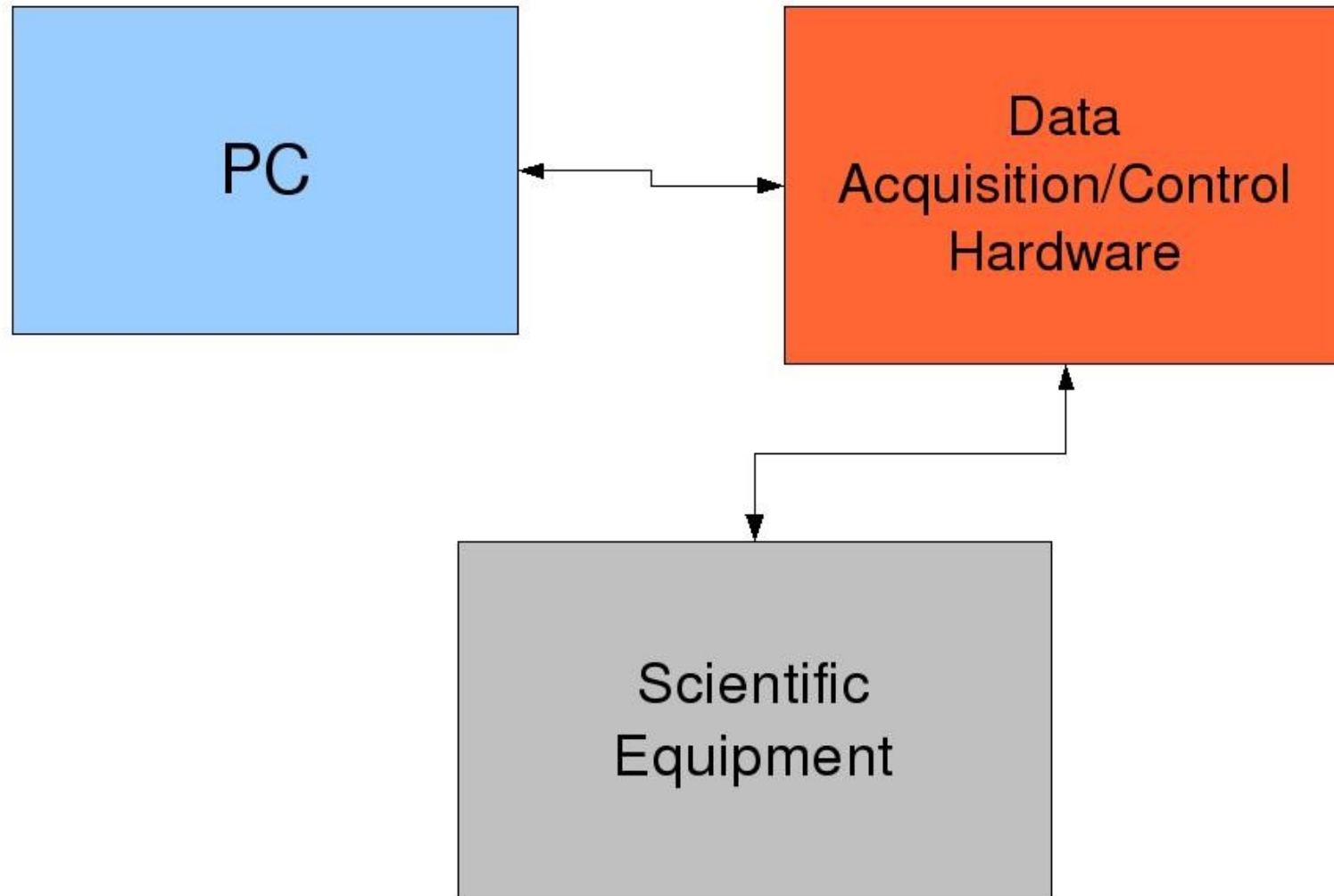


PHOENIX

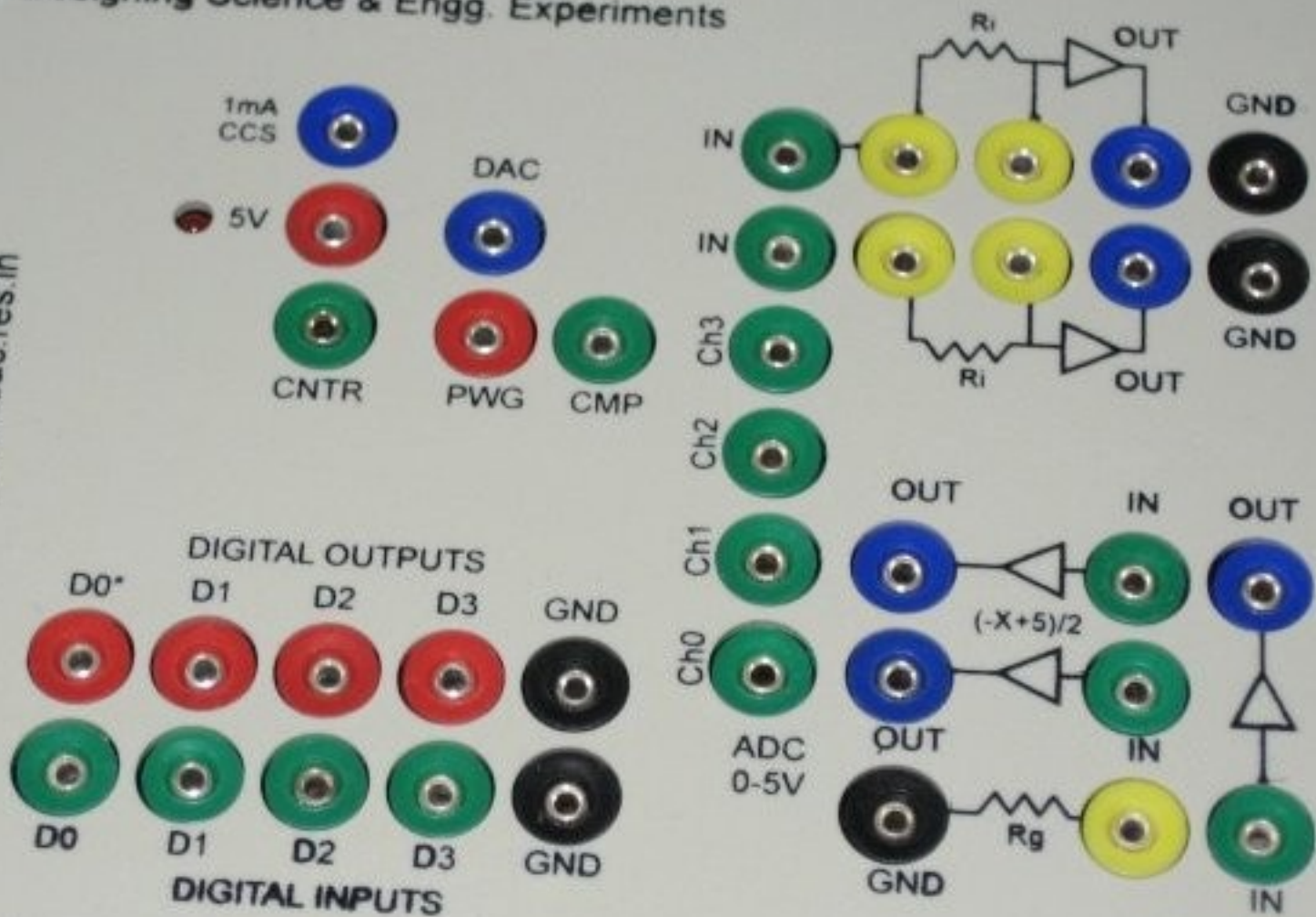
*Physics with Homemade Equipment
and
Innovative Experiments*



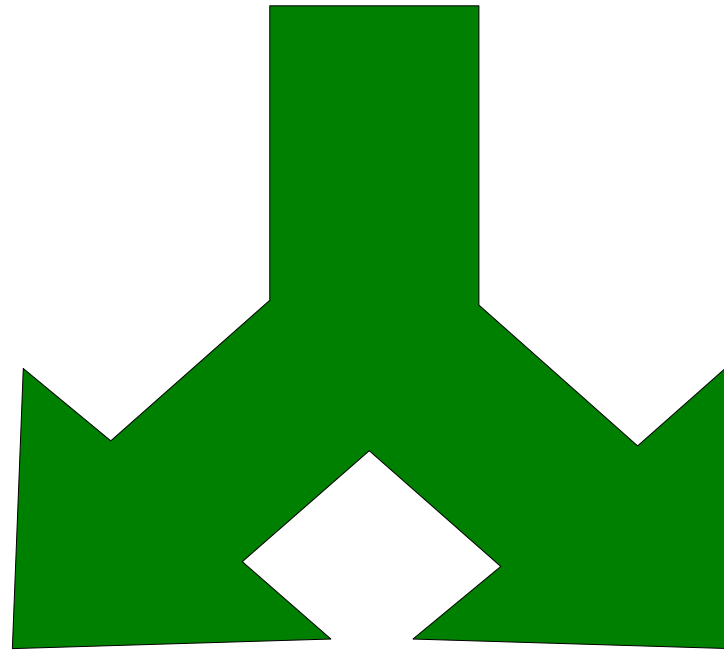
Phoenix Development System

for Designing Science & Engg. Experiments

Designed by
Inter-University Accelerator Centre
New Delhi - 110067 www.iuac.res.in



Features



Programmable
blocks

Non Programmable
blocks

Programmable Blocks

- 4 Digital Inputs: can be read through software
- 4 Digital Outputs: can be set through software
- 4 Analog Inputs: voltages in 0-5V range can be read
- 1 Analog Output: voltages in the range 0-5V can be set
- Frequency Counter: Software can measure the frequency of a waveform at this socket

Non Programmable Blocks

- Constant Current Source: 1 mA for load resistances upto 4 Kohm
- 2 Inverting Amplifiers with plug-in resistors to vary the gain
- 1 Non-inverting Amplifier with plug-in resistor to vary the gain
- 2 Level Shifting Amplifiers: to convert voltages in -5V to 5V range, to 0-5V

Getting Started with Phoenix

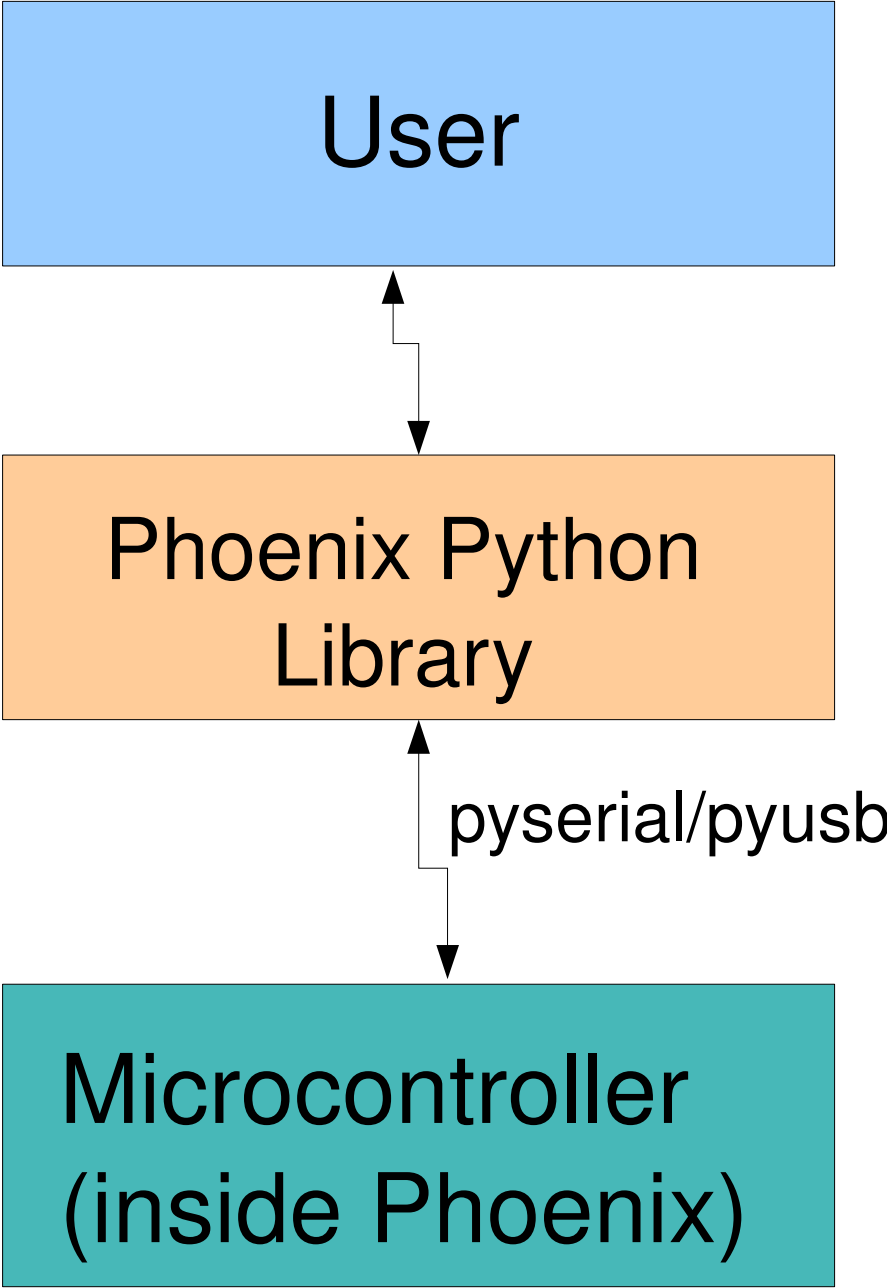
- Software Library for Phoenix enables us to access the programmable pins easily
- Both in C and Python
- Beginners to programming will find Python easier

Why use Python?

- Easy to use – especially for people not familiar with programming.
- Libraries which enable easy communication with the uC.

The Phoenix Python Library

- Class phm
- Communication with the uC using pyserial/pyusb.
- Functions to access each of the programmable blocks



The Phoenix Python Library

- Simple Input/Output Functions
- Block Read Functions
- Time Period Measurement Functions
- Other Functions

Simple I/O Functions

- Digital Inputs: integer = **read_inputs** ()
- Digital Outputs:
None = **write_outputs** (integer dat)
- ADC: [float, integer] = **read_adc** ()
- DAC: None = **set_voltage** (float mv)

Block Read Functions

- Single Channel ADC:

[(float ts, float adval),....] = **read_block** (integer np, integer delay, integer bipolar)

- Multi-channel ADC:

[(float ts, float ad0, float ad1, ..), ..] = **multi_read_block** (integer np, integer delay, integer bipolar)

Time Measurement Functions

Time between rise/fall on different Digital I/O pins

- float = **r2rtime** (integer pin1, integer pin2)
- float = **r2ftime** (integer pin1, integer pin2)
- float = **set2rtime** (integer pin1, integer pin2)
- float = **set2ftime** (integer pin1, integer pin2)
- float = **clr2rtime** (integer pin1, integer pin2)
- float = **clr2ftime** (integer pin1, integer pin2)

Other Functions

- **plot**(list) – Plot Data returned by `read_block()` and `multi_read_block()` using Tkinter
- **save_data**(list, filename = 'plot.dat') – Save Data returned by `read_block()` and `multi_read_block()` to a file

PHYSICS EXPERIMENTS

1. Capacitor

- Exponential Charging/Discharging curves
- Linear charging through constant current source
- Measurement of capacitance
- Measurement of dielectric constant of glass
- Study of variation of dielectric constant with temperature

2. Electromagnetic Induction

- Study of AC mains pickup and analyze the trace to estimate the frequency
- Plot the voltage induced when a magnet is dropped into a coil
- Study the effect of velocity, size and strength of the magnet on the voltage
- Estimate the velocity from the shape of the induced waveform
- Study of mutual induction using two coils and ferrite core

3. Study of Pendulum

- Plotting the damped sinusoidal waveform generated by a pendulum.
- Waveforms generated by coupled pendulum
- Estimation of acceleration due to gravity from the period and length of the pendulum.
- Accurate measurement of period using a light barrier made of photo-transistor.

4. Study of Sound

- Direct measurement of velocity of sound in air, using a sound source and a microphone.
- Study of reflection of sound using 40KHz ultrasound piezo-electric transceiver
- Conversion of electrical signals into sound, creating music.
- Digitization of sound and further analysis.

5. Radiation Detection and Analysis

- Energy spectrum of different α sources, using the radiation detection accessory of Phoenix
- Gamma counting using Geiger Muller tube connected to Phoenix

6. Study of Electronic Circuits

- Diode V-I characteristics curve, using the analog I/O sockets of Phoenix.
- Integration of square wave to get a triangular wave and display both
- Study the RC integration by varying R,C and frequency.
- Characterisation of oscillator circuit outputs using Phoenix as a CRO, frequency counter and timer.

Contributing to Phoenix

- Spreading the word and help conduct workshops in schools/colleges
- Designing and documenting new experiments
- Engg. Students can take up projects based on Phoenix

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