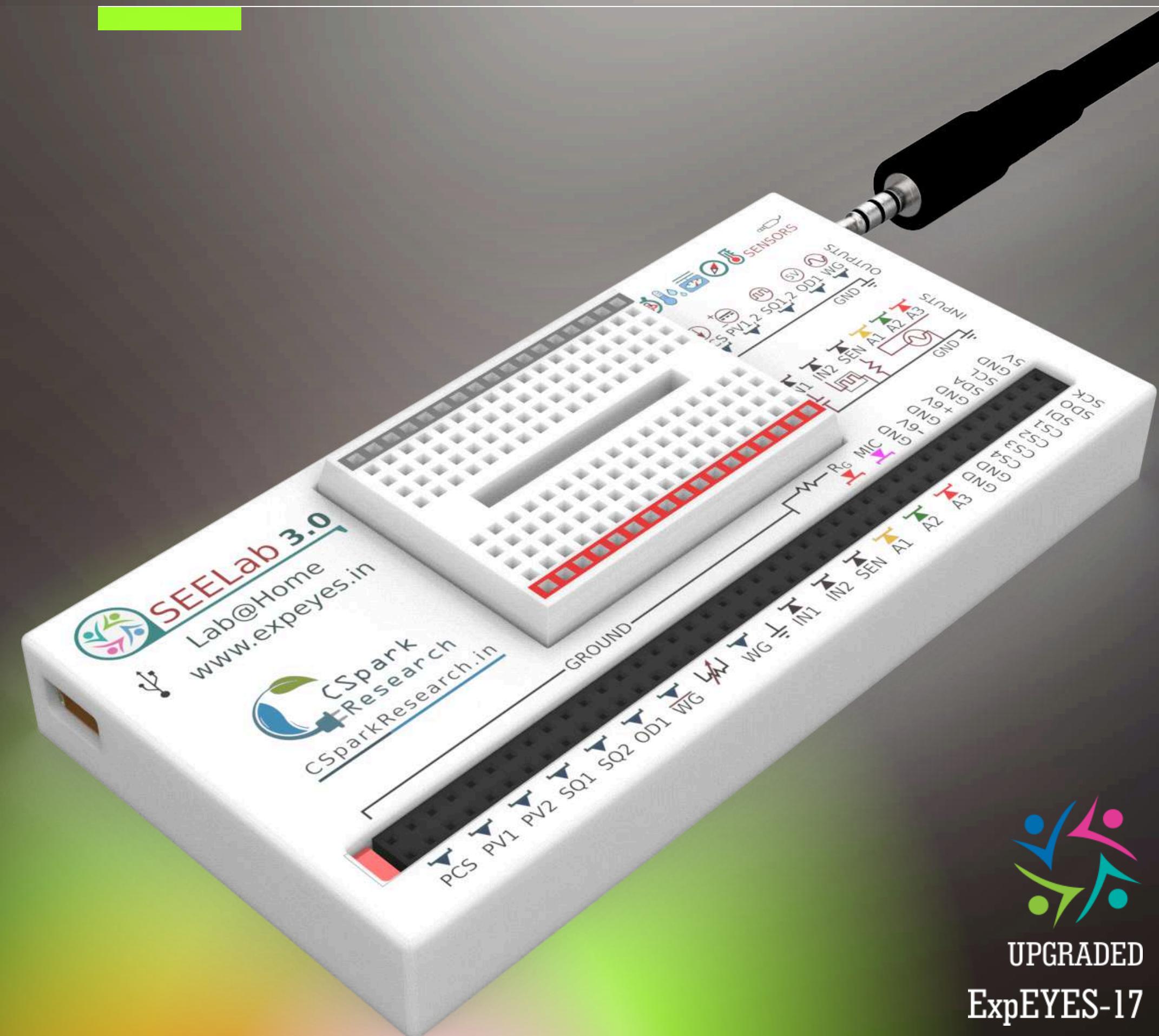
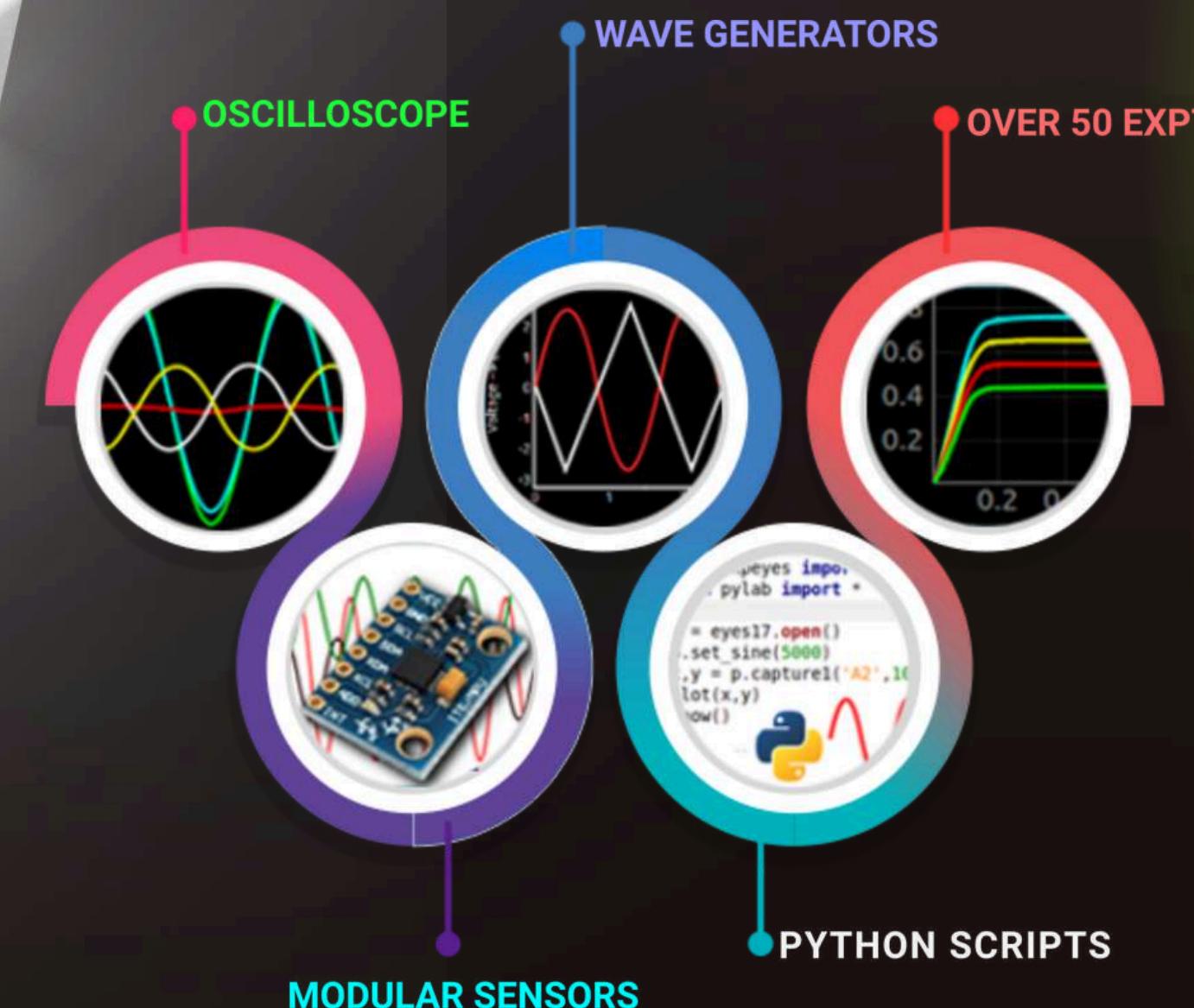


SELab3

A Multi Purpose Test and Measurement Tool



UPGRADED
ExpEYES-17



SEELab3 : YOUR LAB @ HOME

100+ SCIENCE EXPERIMENTS

WAVEGEN

WG , WḠ

The WG Pin outputs a 3 volt amplitude sine/triangle wave signal with adjustable frequency from 4Hz to 5kHz. The amplitude can also be adjusted down to 80mV , and a 180 phase shifted signal is available on WḠ

2MSPS OSCILLOSCOPE

A1 , A2, A3, MIC, SEN, IN1

4 Input channels to record up to a million voltage readings within one second. Useful for studying voltage fluctuations, and calculating frequencies and phase shifts of periodic signal inputs. A1/A2 +/-16Volts, A3: +/-3V, MICrophone Input, and an internally pulled up SEN input. Also used as 12 bit voltmeters

VOLTAGE SOURCES

PV1 PV2 OD1 5V +/-6V

12 bit programmable outputs PV1: +/-5V, PV2: +/-3 V. 5V Direct USB power. +6V and -6V for powering Op-Amp circuits. OD1 digital output

SQUARE WAVE

SQ1 SQ2

0 to 5V Square wave outputs with adjustable frequency and duty cycle. 0.015Hz to 1MHz. Output Impedance 100Ohm.

Measure digital signal timings on IN2/SEN

RC METER

SEN IN1

Measure resistance and capacitance



PIN DIAGRAMS AND FEATURES

Pocket Sized Version : SEELab3

PYTHON PROGRAMMABLE

Access all control and measurement tools via the Python library or the PyQt based graphical software for Ubuntu/Windows
dev=eyes17.open(); print(dev.get_voltage('A1'))

VISUAL PROGRAMS

Connect easy drag and drop blocks to create programs which can collect, visualize, and analyze data

CROSS PLATFORM

Supported on Ubuntu/Windows/Android. Plug and play via USB.



DATA ANALYSIS TOOLS

Implements feature extraction tools such as curve fitting for sinusoidal and exponential decay data. Precisely determines frequencies, phase shifts, decay factors, offsets and amplitudes.

ADD-ON SENSORS

SPI / I2C

USE the SPI (SCK,SDI,SDO,CS1-4), or I2C(SCL,SDA pins) buses to enhance experiments. Plug and play over a dozen sensors for physical parameters such as pressure, magnetism, luminosity, humidity, distance etc. control precision waveform generators, servo motors, and robotic arms

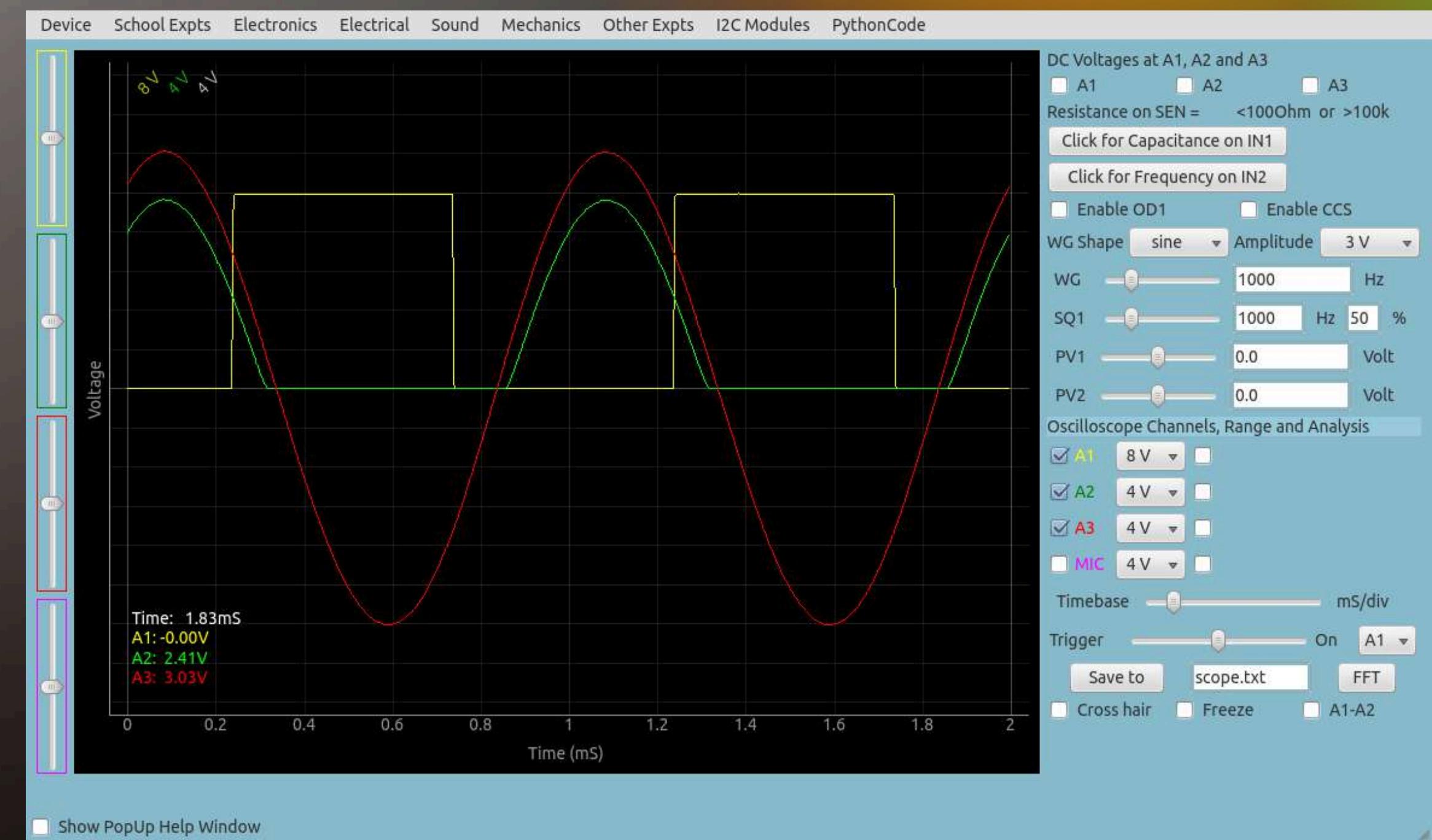


Successor to ExpEYES-17

The SEELab3 kit Contains an essential set of tools for Electronics and Science Labs

Input Instruments

- 4 Channel Oscilloscope
 - Up to 2 Million Voltage Readings per second.
 - 2 +/-16 Range Inputs (A1, A2)
 - Software adjustable Input range
 - +/-3V A3 input with Manual gain
 - MIC Input for condenser microphones
- Capacitance Measurement 10pF to 100uF.
- Resistance Measurement.
- Frequency and Timing Measurements.
- 12 bit voltmeter and data logger.
- Analytical tools for extracting frequency, phase difference, amplitudes, Fourier transforms etc.



Desktop Application for Windows/Linux showing signals input to A1, A2, A3

Compatible with PCs as well as Android Phones.

Output Instruments

Waveform Generators

- WG: +/-3V Sine Wave generator. 4Hz to 5000Hz. Amplitude attenuable to 80mV
- SQ1,SQ2: 0-5V Square Wave outputs. 0.1Hz to 1MHz
- Optional Add-On Module for 24-Bit sine wave generator up to 2MHz. 0.015Hz step size.

Voltage Outputs

- PV1 : 12 bit, +/-5V voltage source. 20mA
- PV1 : 12 bit, +/-3V voltage source.
- PCS: 12 bit constant current source. max 3mA

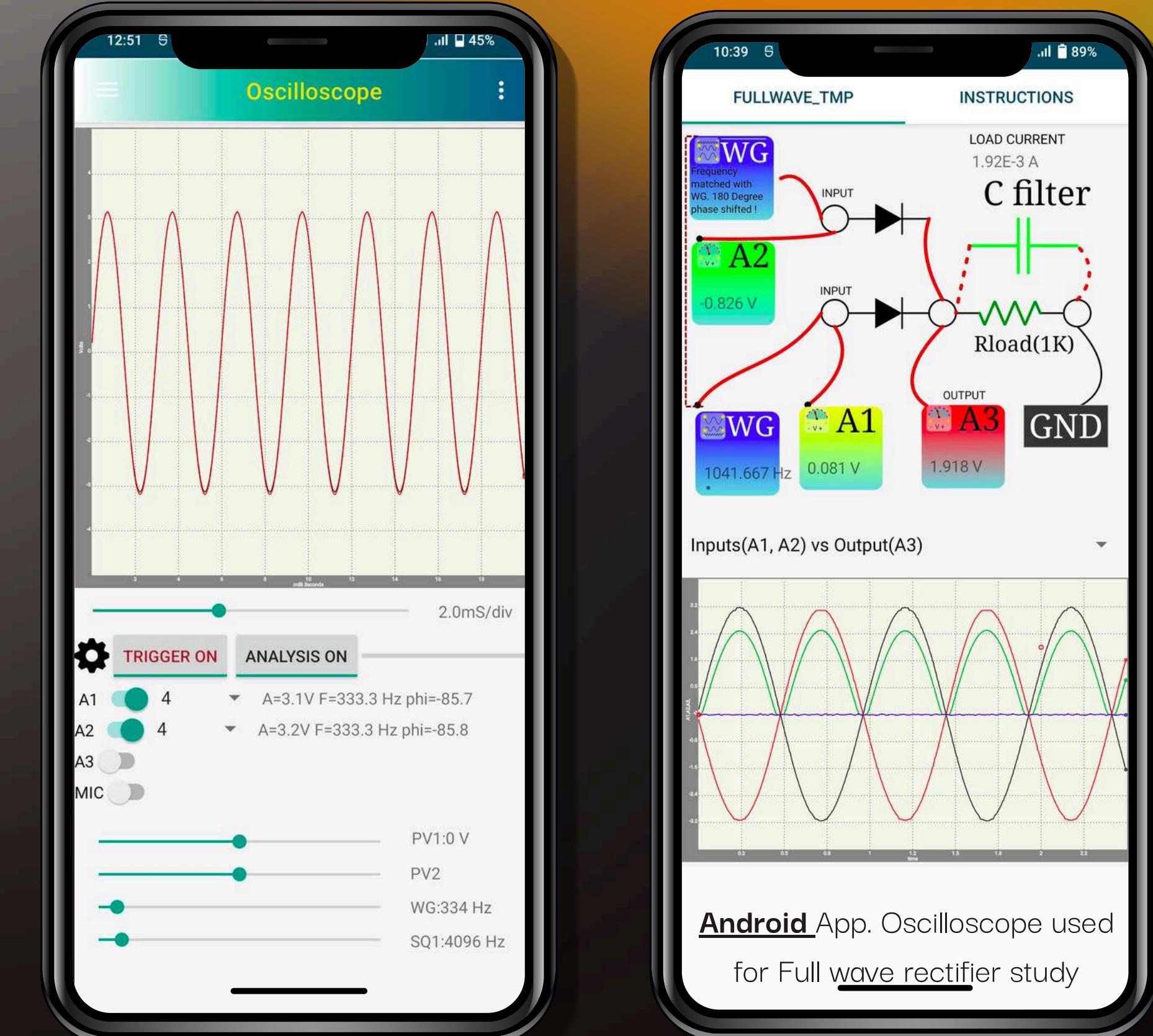
Digital outputs ; 0-5V outputs

- OD1, CS1, CS2, CS3, CS4

Volta



Download the SEElab 3.0 App
3000+ active community.(Google Play)

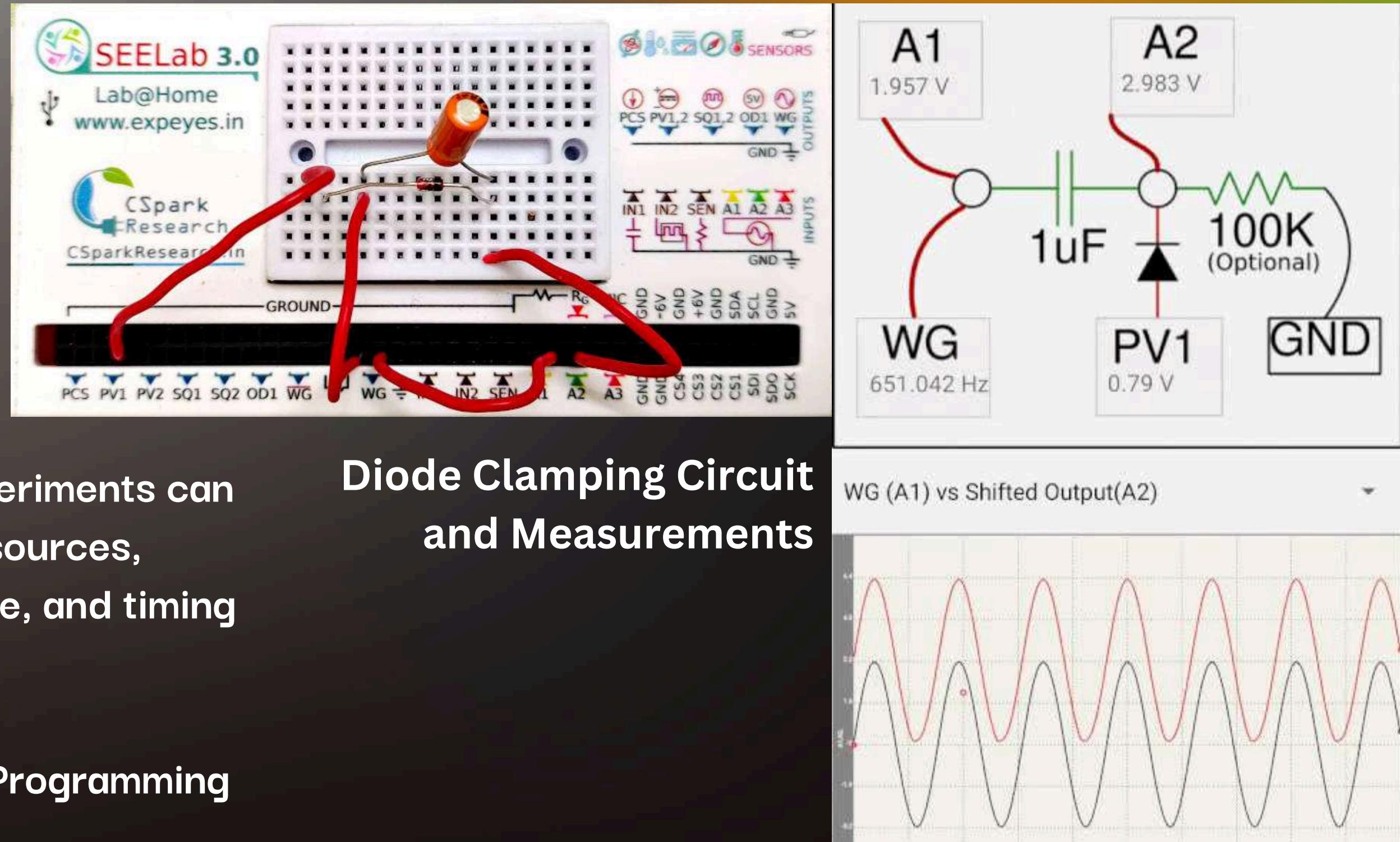


Android App. Oscilloscope used
 for Full wave rectifier study

Over a 100 experiments can be performed with this collection !

Electronics 101 Lab

- Transistor CE Characteristics
- Full and Half Wave Rectifiers
- Opamp amplifier circuits
- Diode Clipping/Clamping Circuit
- Summing Amplifier
- Logic Gates, Clock dividers
- Many more characterisation experiments can be performed using the voltage sources, waveform generator, oscilloscope, and timing measurements
- Embedded Circuit simulator
- Programmable in Python/Visual Programming



Introduction : Experiments

New Desktop App



Installation

Currently available on PyPi

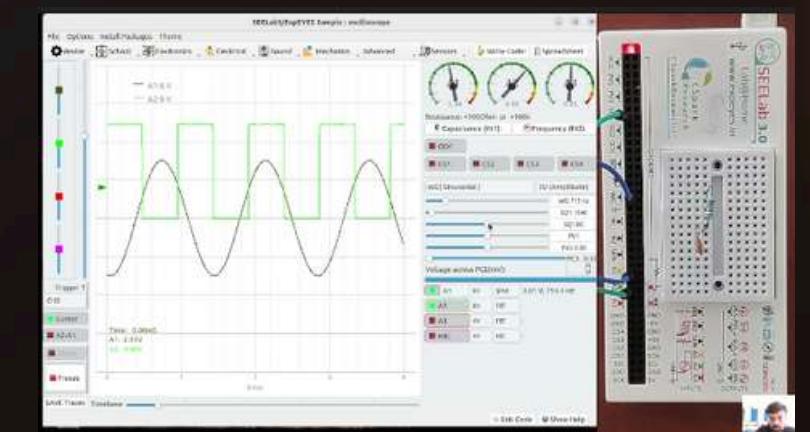
WINDOWS

- Install Python(Make sure The path option is enabled
- open cmd
- python -m pip install --upgrade pip
- python -m pip install seelab_examples
- python -m seelab_examples

Linux

- pip install seelab_examples
- seelab_examples

Includes embedded python notebook, circuit simulator, visual programming, and AI based computer vision examples.



[INTRODUCTION \[VIDEO\]](#)

Introduction : Experiments

Categorized into clear skill levels ranging from school to post graduate experiments

ExPEYES17 SEE Lab 3.0

learning by doing!

EXPERIMENTS

- OSCILLOSCOPE**: A screenshot of the software interface showing an oscilloscope displaying waveforms.
- DATA LOGGER**: A screenshot of the software interface showing a data logger interface with multiple analog inputs and a graph.
- VISUAL CODING**: A screenshot of the software interface showing visual programming blocks for controlling the device.

Getting Started
A collection of simple introductory topics such as measurement of voltage, resistance, capacitance etc.

School Level
Fundamental concepts taught in High School. lemon cell, AC/DC , echo sensor, AC generator using coil etc..

Electrical
RL , RC , RLC steady state and transient responses. Bode plots, and filter characterisation

Electronics
Learn about simple circuits such as Rectifiers, Filters, Diode and transistor Characteristics ...

Mechanics
Simple pendulum, monitoring a mass spring system using a LIDAR, time of flight ...

Acoustics
Sound experiments : Measuring sound waves, speed of sound, fourier transforms, interference of sound(beats) etc

DC Voltmeter
Measure a DC Voltage from a source such as a battery

Measure PV1
Measure the voltage of the adjustable voltage source PV1

Measure Capacitance
Measure capacitance value of different capacitors

Measure Resistance
Measure resistors in series and in parallel

Study of LDR
Observe the behaviour of a light dependent resistor

Ohms Law
Study DC Ohm's Law

Lemon Cell

Study An Electromagnet
Pass current through a coil to create a magnetic field and observe its effect on a permanent magnet

Driven Pendulum
Use a solenoid connected to an AC source to push a hanging permanent magnet back and forth. Study resonance

Electromagnetic Induction
Drop a magnet through a solenoid, and visualize the voltage signal induced due to the changing magnetic flux.

Simple AC Generator
Use a solenoid and a rotating magnet to generate electricity

Direct and Alternating Currents
What is AC? What is DC? What is a mixed signal?

AC Through A Resistor
Behaviour of AC current flowing through a resistor

AC Through A Capacitor
Behaviour of an AC current flowing through a capacitor

AC Through An Inductor
Behaviour of an AC current flowing through an inductor

AC Through Series LCR
Behaviour of an AC current flowing through a series LCR Circuit

Measuring the Conductivity of Water
Measure AC and DC conductivity of water

AC Resistance of Human Body
Measure resistance of the human body with an AC signal

Mutual Induction
Use 2 coils and create a working model of a transformer

EXPEYES-17 Your Lab@Home

DO F19S

AC Powerline Pickup
Understand electrical noise due to 50/60Hz power lines surrounding us

Generating and Digitizing Sound
Measure sound and visualize it

Stroboscope
Measure speed of a rotating object using a flashing LED

Distance using ultrasound echo module SR04
Measure distance using an SR04 Echo module

Optical Communication
Transmit signals from one device using a laser connected to SQ1, and receive on another device

HELP DRIVEN PENDULUM

DRIVEN PENDULUM

LISSAJOUS Plot A1 Vs A2
XY plotting, Lissajous figures
Make Lissajous figures by plotting A1 vs A2

AC-DC Separating
Separate AC and DC components from a mixed signal

Duty Cycle measurement
Measure Duty Cycle(Ratio of ON vs OFF Time) on digital inputs IN2/SEN

RC Transient
Study transient behaviour of RC Circuits

RL Transient
Study transient behaviour of RL Circuits

RC Transient
Study transient behaviour of RLC Circuits

Fourier Transformations
Take the fourier transform of sinusoidal

XY plotting, Lissajous figures
Make Lissajous figures by plotting A1 vs A2

RLC Steady State
Study Steady State behaviour of RLC Circuits

Study of Filter circuits
Study passive and active filters. Plots amplitude and phase vs frequency

Ohms Law using AC
Study Ohm's Law with AC signals using their RMS amplitude

Duty Cycle measurement
Measure Duty Cycle(Ratio of ON vs OFF Time) on digital inputs IN2/SEN

Output Impedance
Study Output Impedance

2 Phase AC Generator
Use 2 solenoids and a rotating magnet to generate 2 phase electricity

3 Phase AC Generator
Use 3 coils and a rotating magnet to generate 3 phase signals

Universal Voltage Tester

HELP

STUDY AN ELECTROMAGNET

Place a Compass or a small magnet suspended from a string to observe the magnetic field.

A1
0 V
RMS

PV1
3.87 V

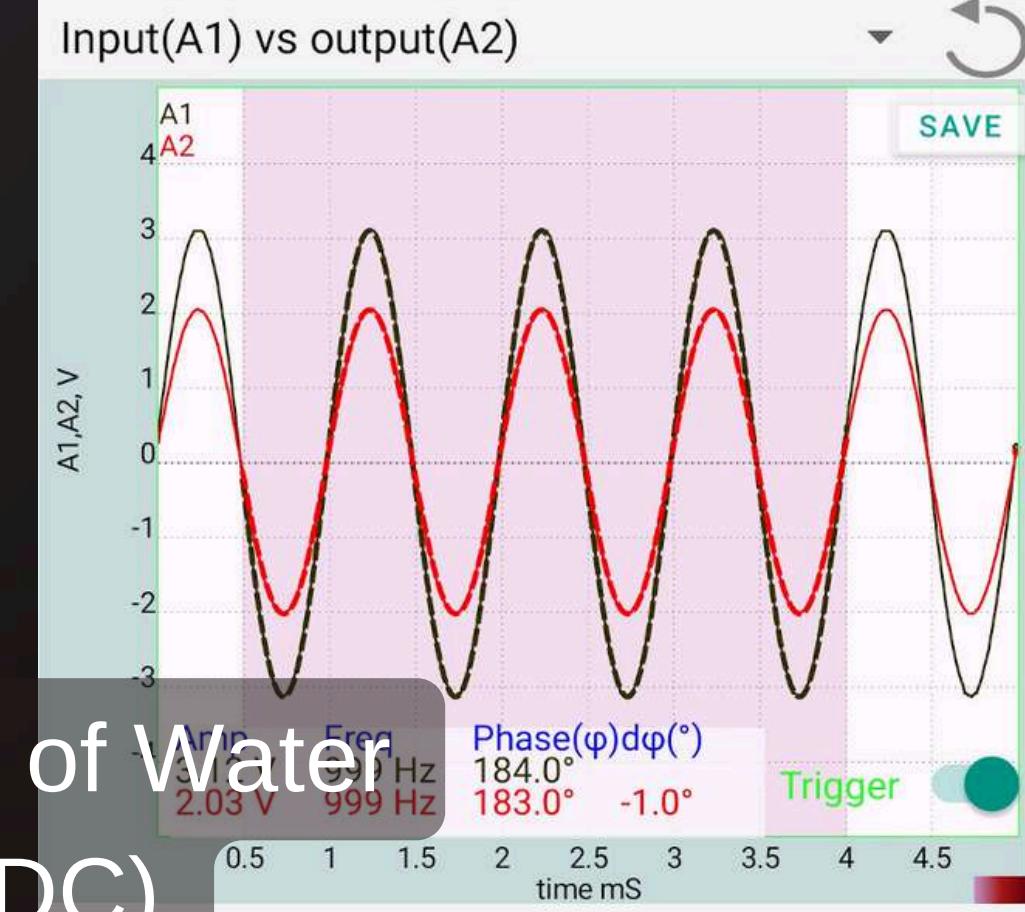
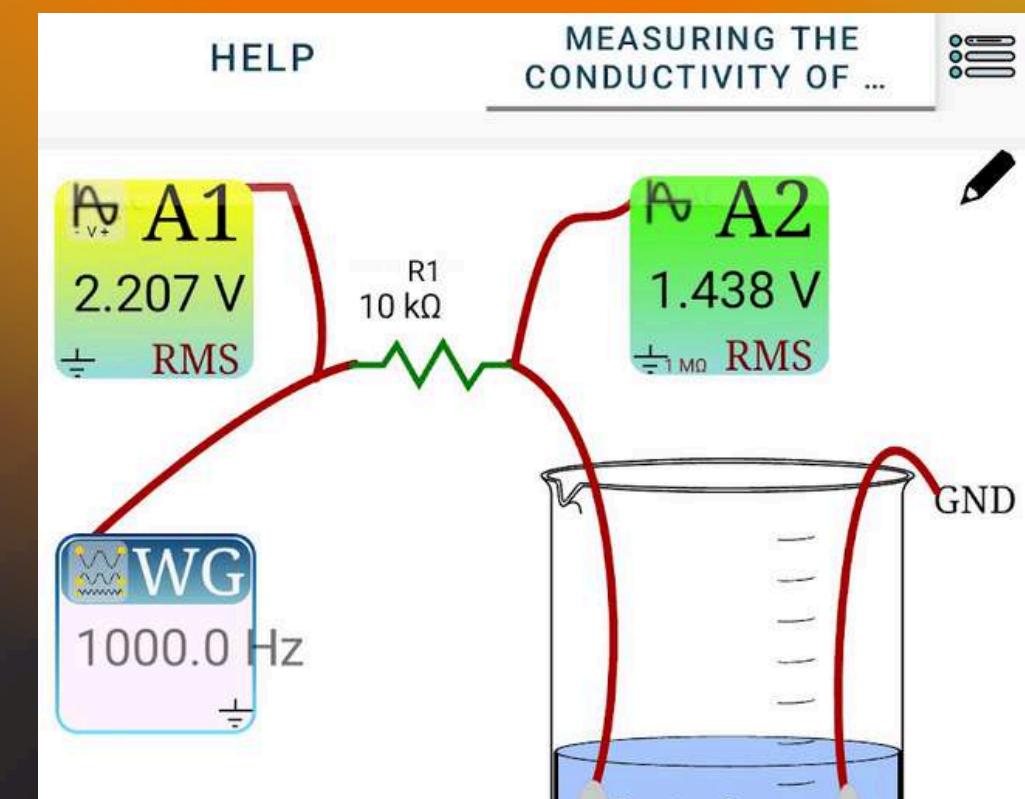
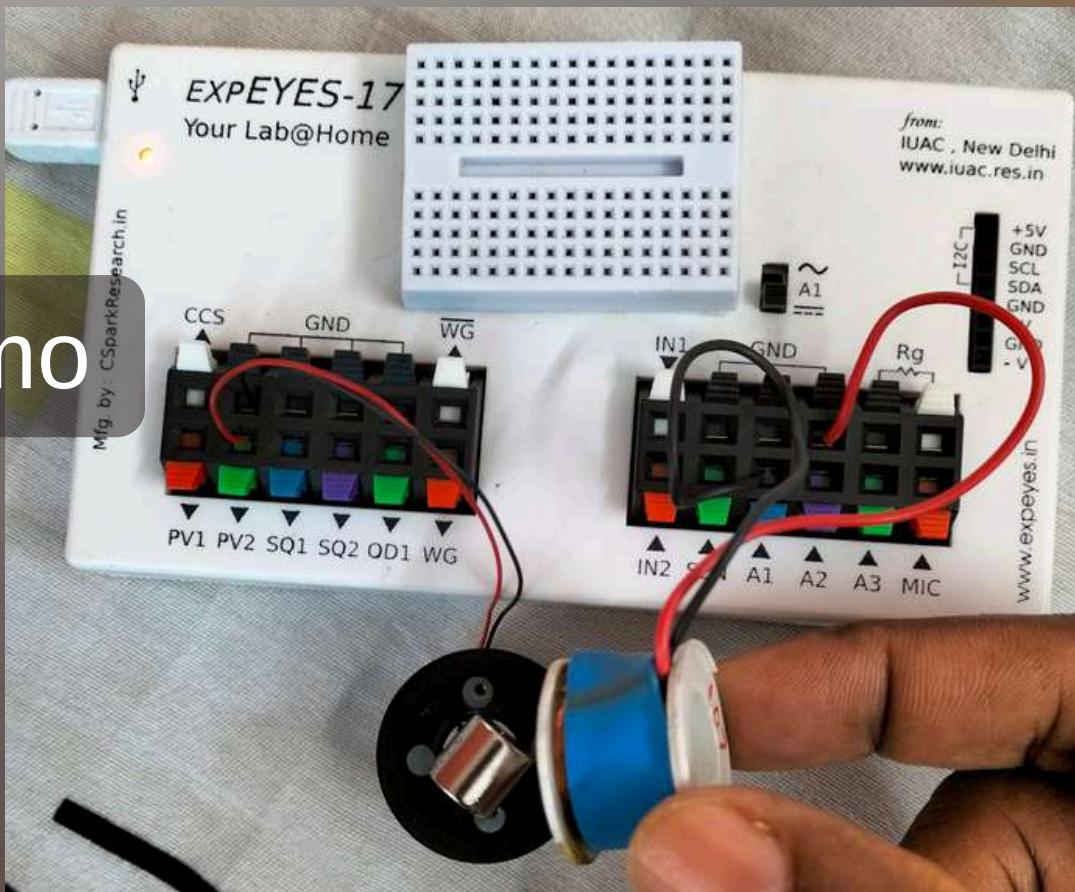
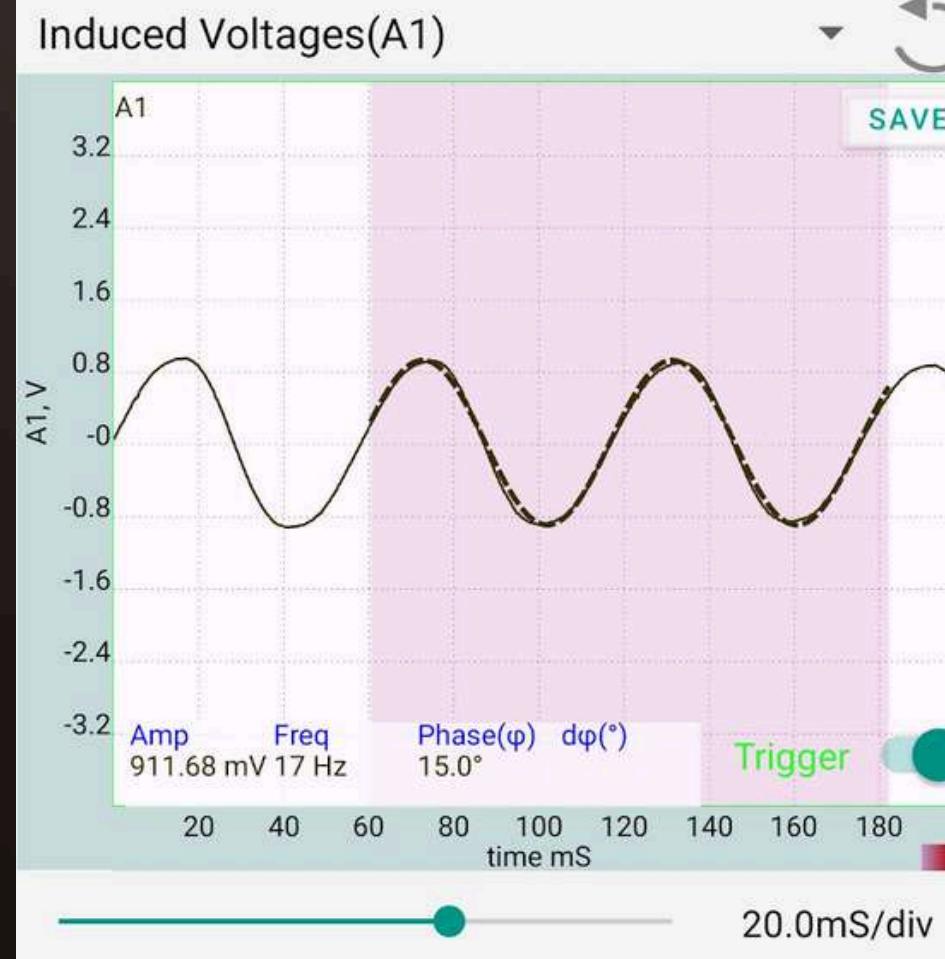
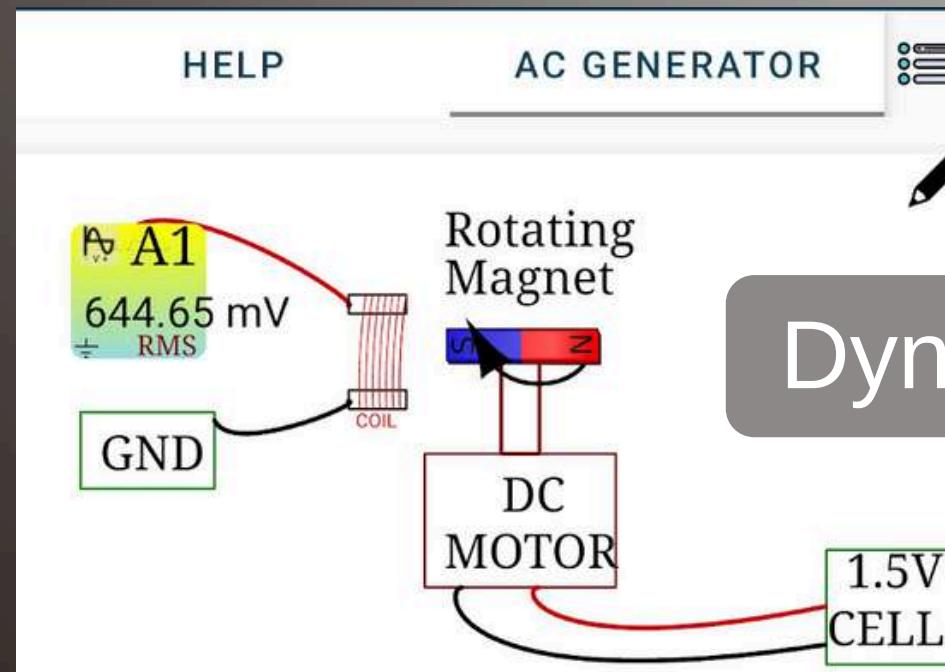
PV1
5 Hz

GND

Choose PV1 instead of P1 to create an oscillating field

Electricity & Electromagnetism

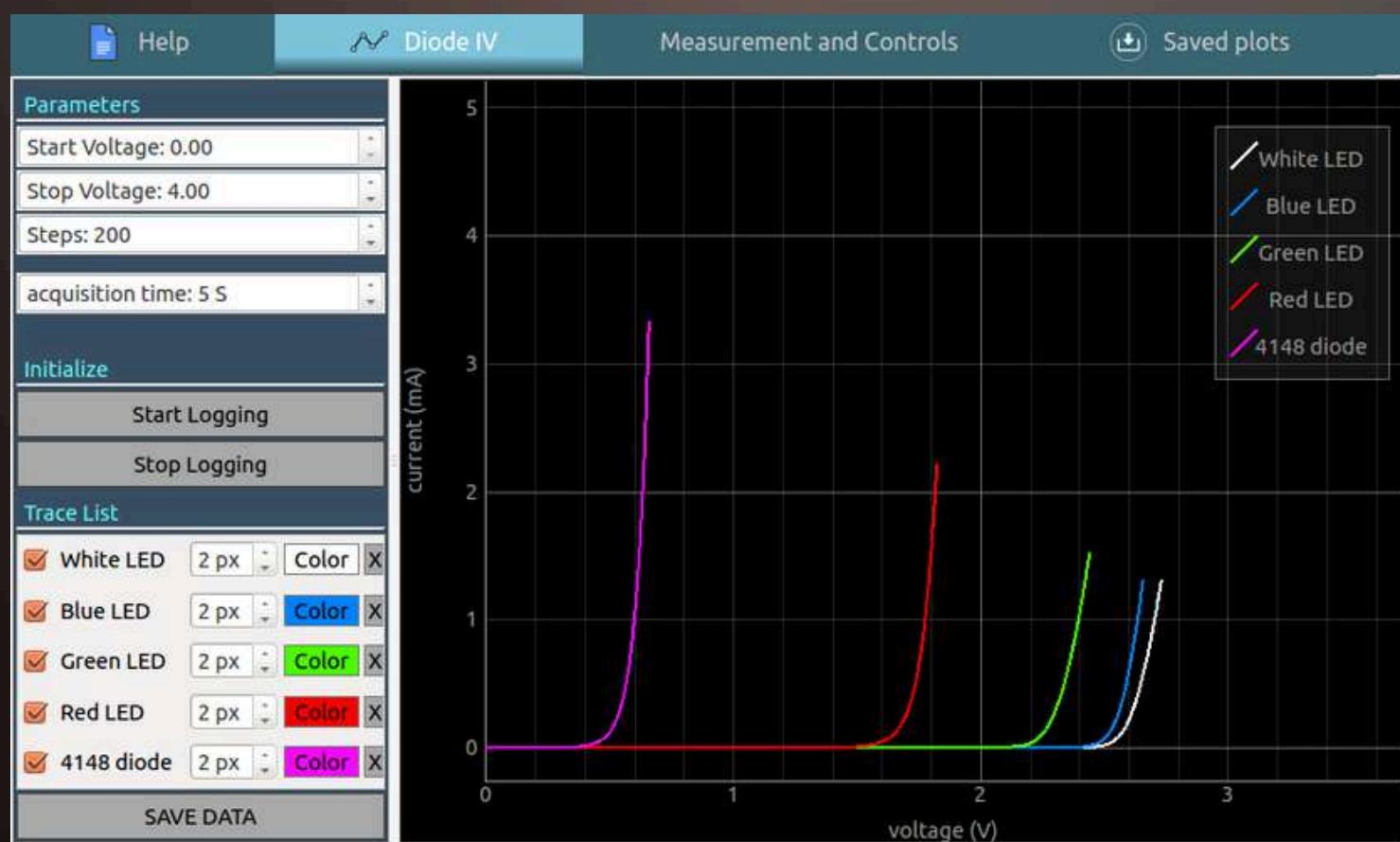
Introduction : Experiments



Electronics 101 Lab

- LCR Resonance
- Frequency response of band pass/low pass/high pass filters [Bode Plots]
- Diode IV Characteristics

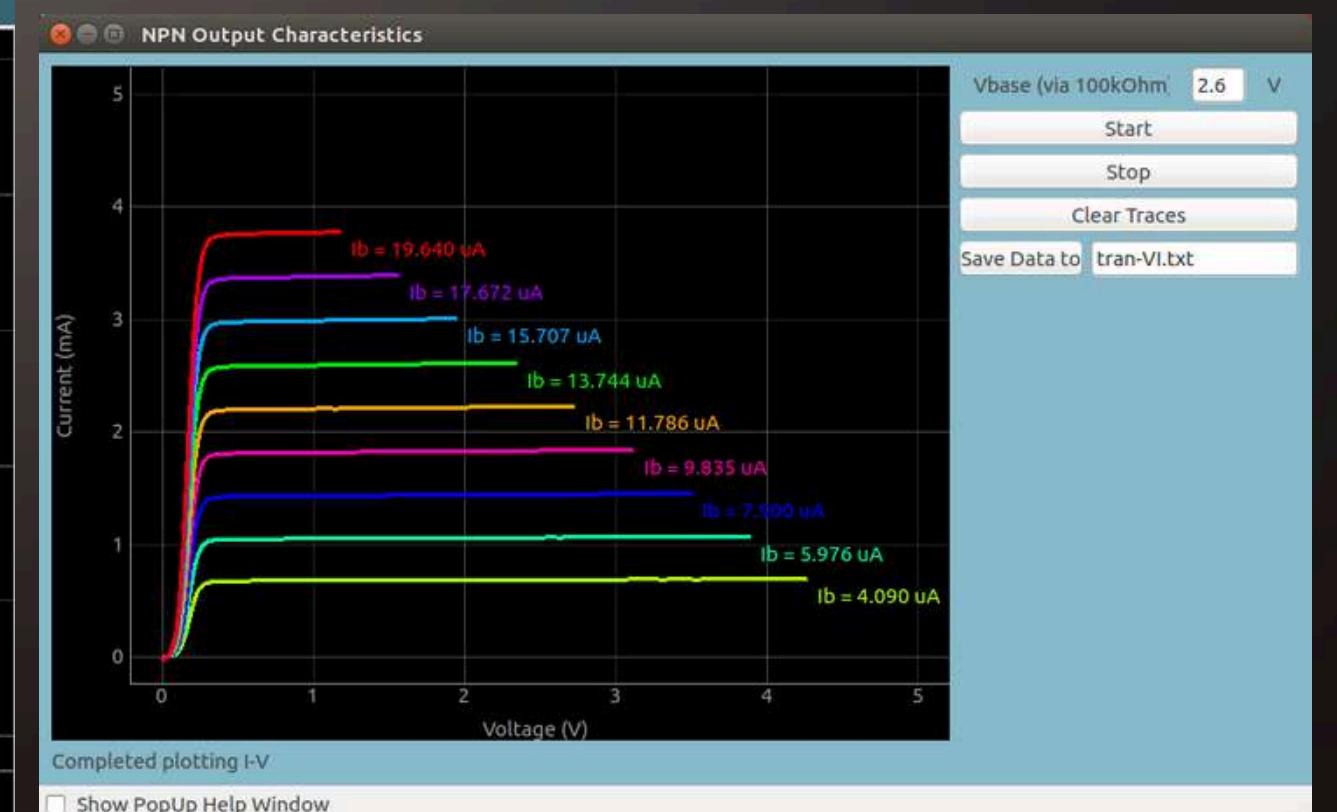
Verify formulae for capacitive and inductive reactance using precisely extracted phase shifts



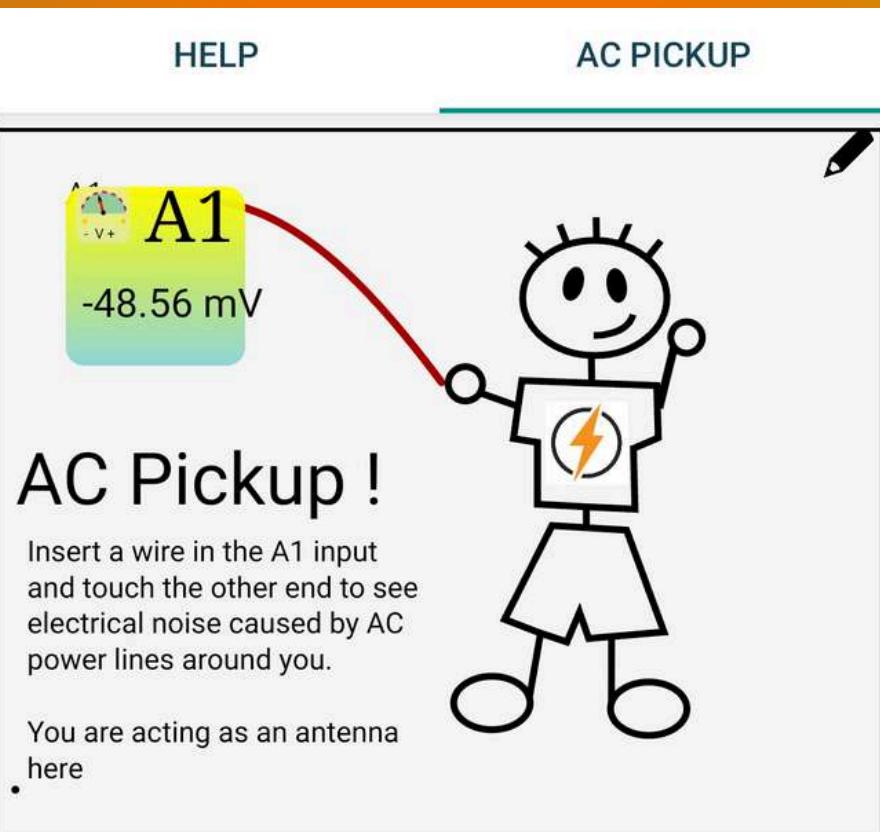
Diode IV Characteristics for various diodes and LEDs



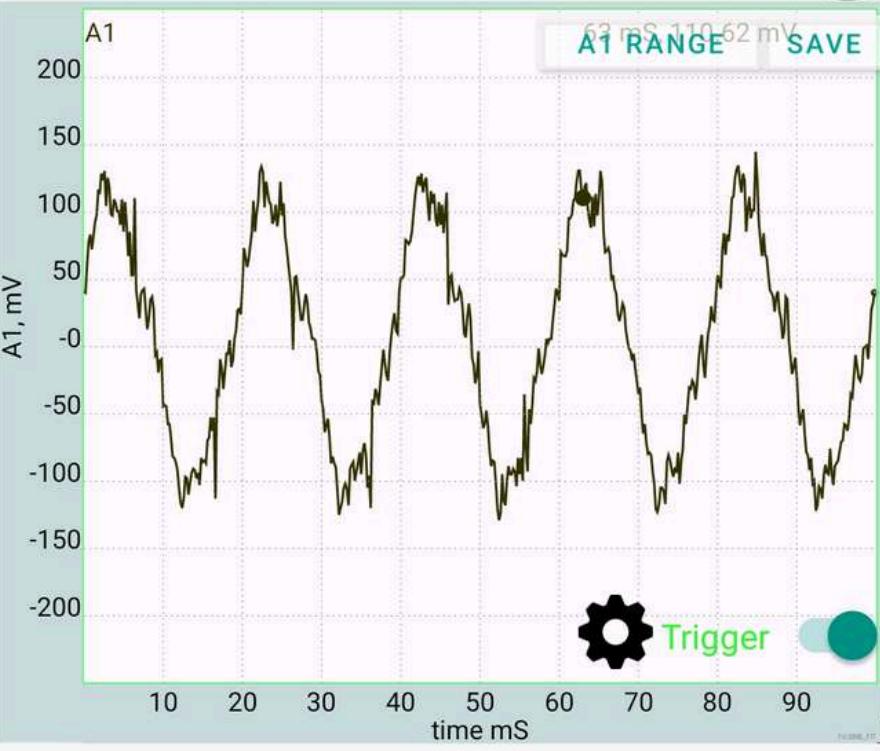
LCR Resonance Curve



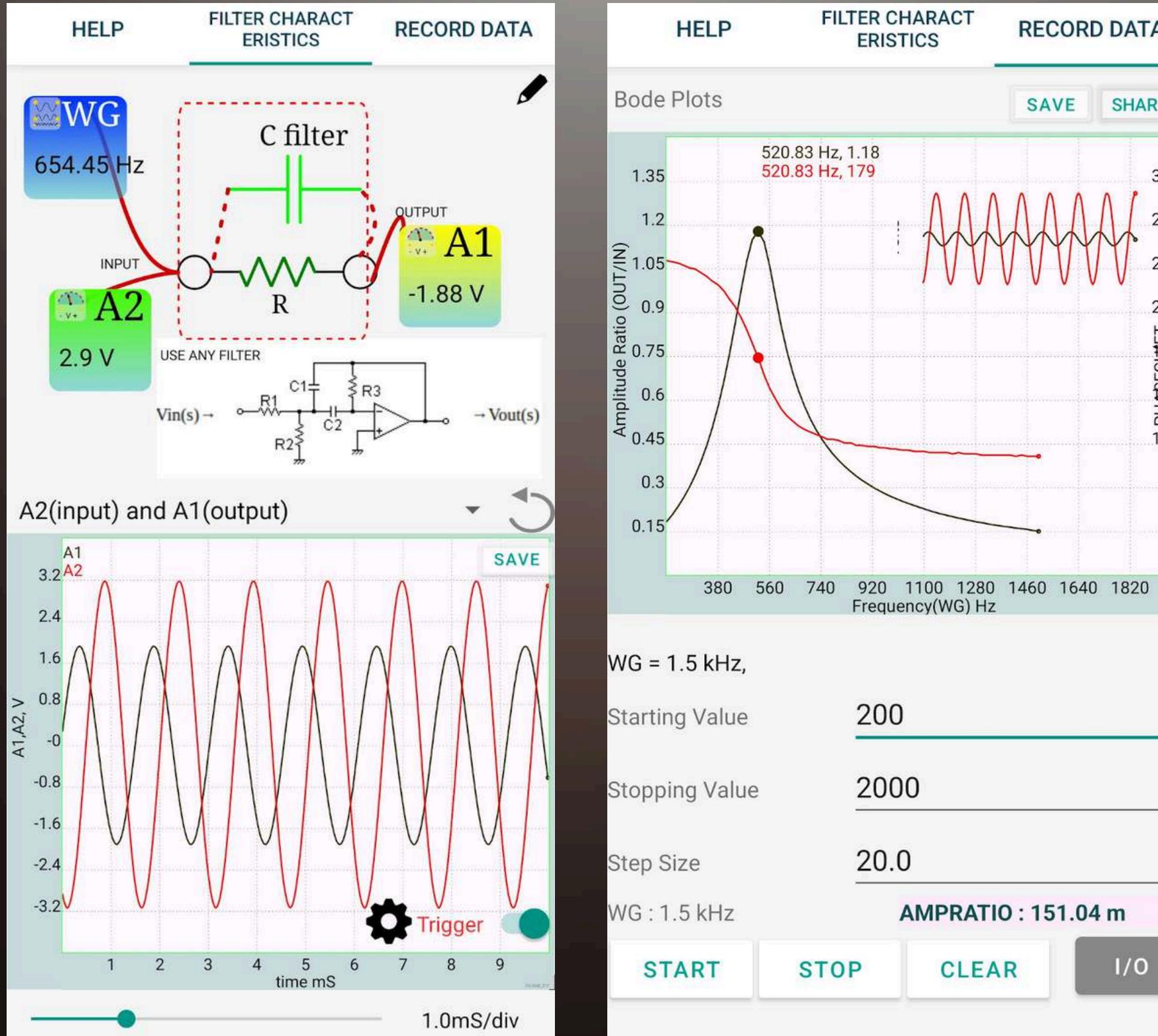
Transistor Output Characteristics



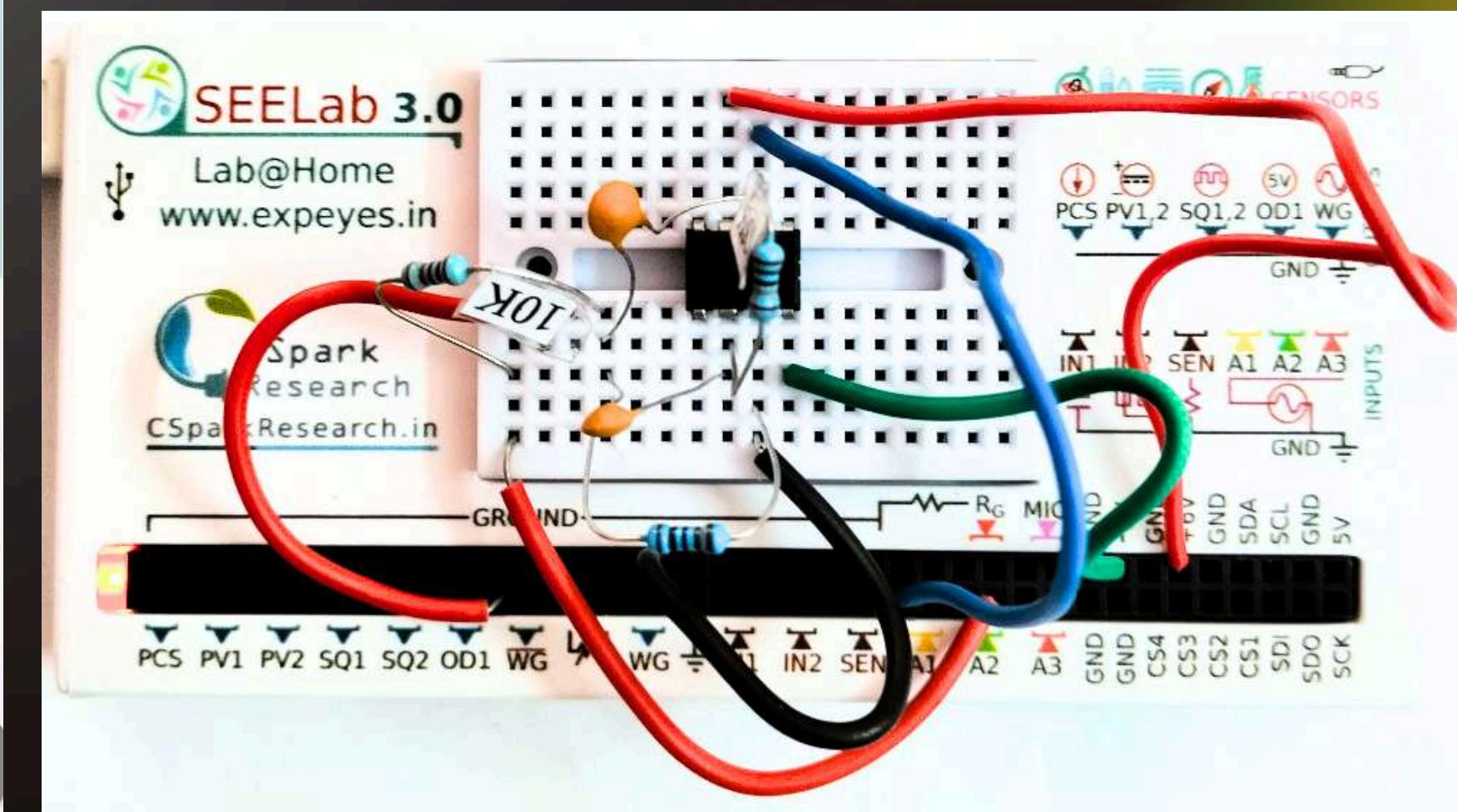
Picked up Voltage(A1)



50 Hz NOISE



Advanced Electronics: Characteristics of a band pass filter

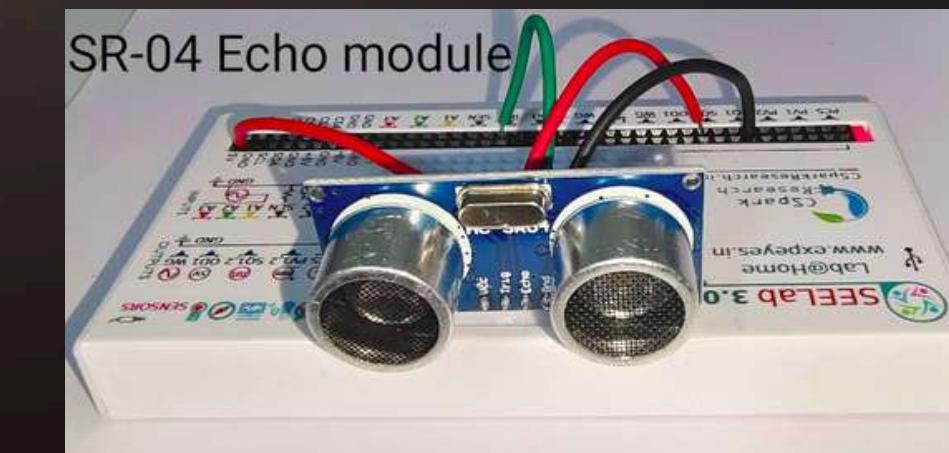
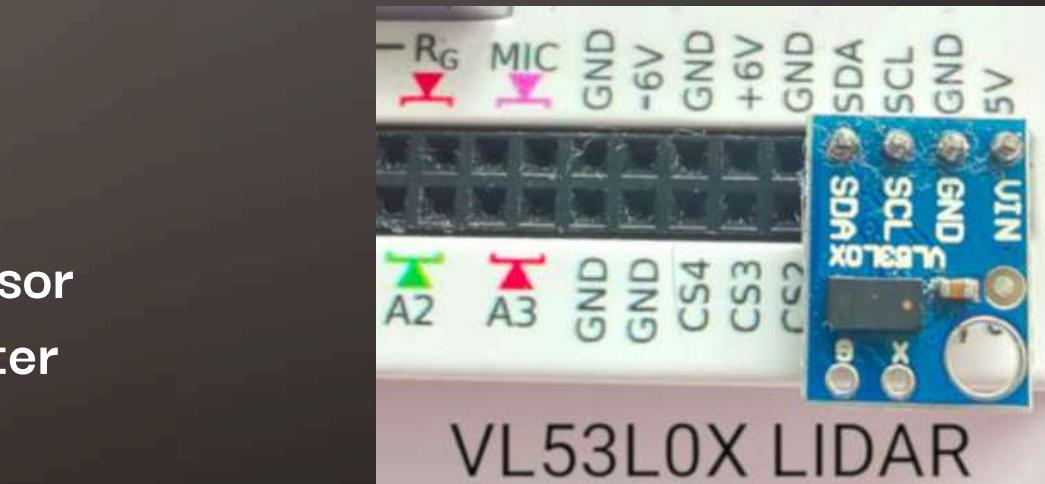




Low cost add-ons : Simply plug 'n play

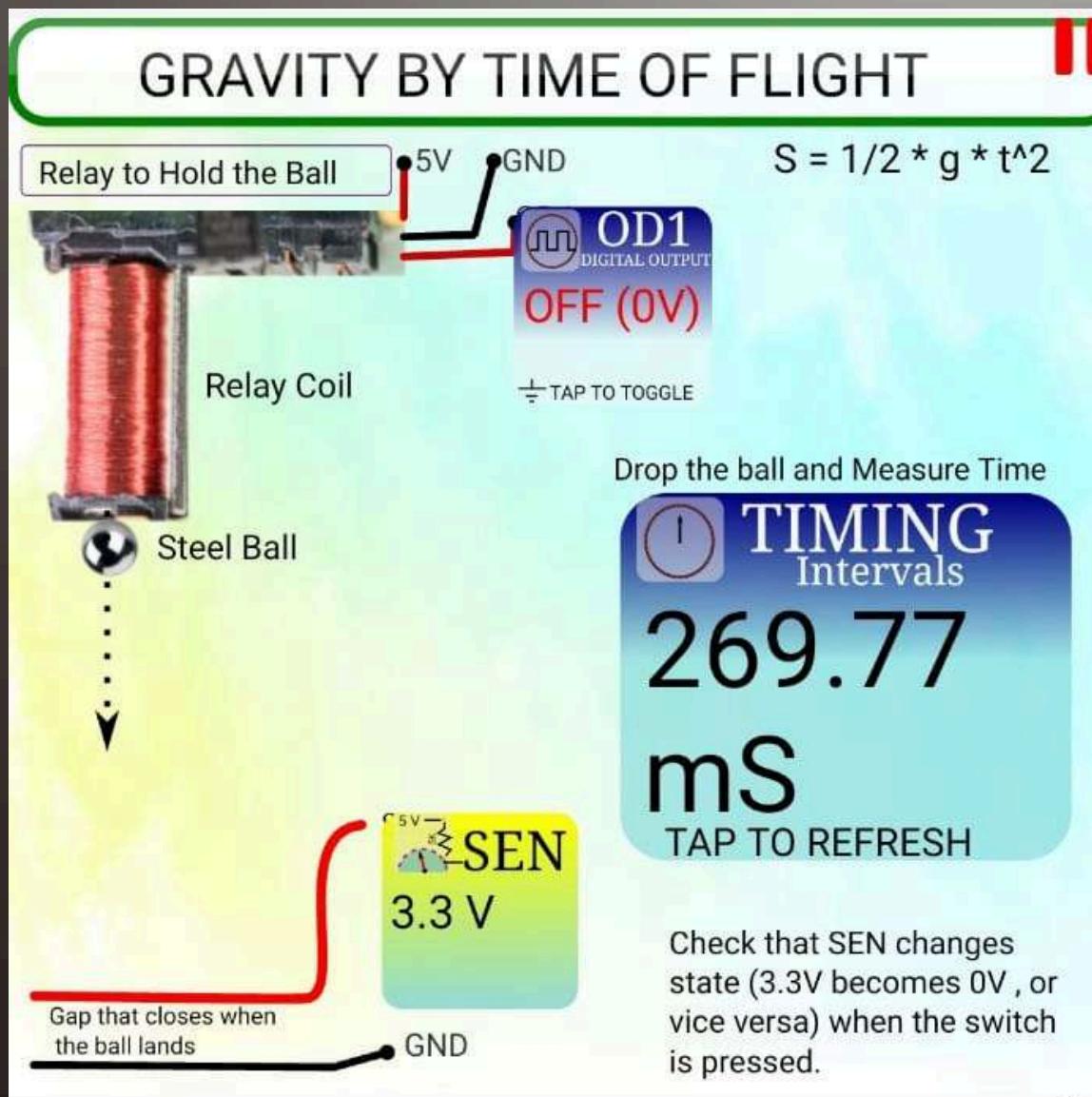
I2C/SPI communication interfaces, and software support for several common sensors

- BMP280 : Pressure and temperature Sensor
- BME280: Humidity measurement
- TSL2561/BH1750: Light intensity sensor
- MPU6050: Gyroscope, accelerometer
- MPU9250 : Accel/Gyro/Magnetic Fields
- VL53L0X : Distance measurement (LIDAR)
- MLX90614: Passive IR temperature sensor
- AD8232 : ECG instrumentation amplifier
- AD9833: Precision Sine Wave generator
- Servo Motors via SQ1, SQ2, or PCA9685
- AHT10, AHT21: Humidity Sensor
- MAX44009; Visible Spectrum Luminosity sensor
- QMC5883L/HMC5883L : 3 Axis Magnetometer
- ML8511 : UV sensor
- MAX30100: Heart rate and pulse oximetry
- INA219 : High Side Current Sensing
- ADS1115 : 16 bit , 4 channel voltmeter
- TCS34725 : RGB Color sensor
- ADXL345: 3 axis accelerometer
- SR04 : Distance sensor (Sound based)



TIMING MEASUREMENT OF PROJECTILES

Add on accessories



CALCULATIONS:

$$0.5 * 9.8 * .26977 * .26977 =$$

$$0.35660167921$$



Get precise results!

Visual programming interface : Simple blocks for making all sort of measurements.

The screenshot displays a visual programming environment with a sidebar of categories and a main workspace with blocks and a plot.

Sidebar Categories:

- Minimize
- Variables
- Values
- Operators
- Logic
- In / Out
- Loops
- Math
- Lists
- PLOTS
- Functions
- ExpEYES

 - Captures
 - Analysis
 - Sensors
 - Sliders

- Phone
- Games

Blocks in Main Workspace:

- READ VOLTAGE A1
- Scan I2C port, and get a list of detected sensors
- SET VOLTAGE PV1
- Scan I2C port, and get detected sensors in a comma separated string
- Sine(WG) Amplitude 3V
- Read I2C Sensor: BMP280 Address: 13
- SET FREQUENCY WG
- Read SR04 Distance(cm)
- READ FREQUENCY IN2
- Read BMP280 PRESSURE
- READ RESISTANCE SEN GND
- Read MPU6050 Ax
- READ CAPACITANCE pF IN1 GND
- Read Temperature from MAX6675 Module on CS1
- Rising Edge Timer IN2 rising Skip: 0 Timeout: 2
- SET OD1 ON
- Digital Timer IN2 rising Edges: 4 Timeout: 2 First edge starts the timer [t1=0]
- Digital Timer SET OD1 ON at t=0 IN2 rising Edges: 4 Timeout: 2
- SERVO SQ1 Angle
- Read VL53L0X Distance(mm)
- Read HMC5883L Hx
- Read QMC5883L Hx
- Read MAX30100 RED LED Heart Rate
- Read ML8511 UV Light mW/cm²
- Set AD9833 CS1 Frequency
- SERVO(PCA9685) 1 Angle
- Select A1 Range: 16 V
- Oscilloscope Trigger Channel 1 Level: 512
- Capture 1 | A1 SAMPLES 100 TIMEGAP(uS) 1 Data In Variables: timestamps data1
- Capture 2, Chan 1: A1 Chan 2: A2 SAMPLES 100 TIMEGAP(uS) 2 Data In Variables: timestamps data1 data2
- Capture 4 | Chan 1: A1, Chan 2: A2 SAMPLES 200 TIMEGAP(uS) 5 Data Variables: timestamps data1 data2 data3 data4
- Capture And Plot Chan 1: A1 Chan 2: A2, SAMPLES: 500 TG(uS): 5 timestamps data1 data2
- Amplitude ANALYZE ARRAY X[]: ARRAY Y[]
- Amplitude Ratio[Gain] ANALYZE ARRAY X[]: ARRAY Y[] ANALYZE ARRAY X2[]: ARRAY Y2[]
- Fourier Transform Time Array X[]: Amplitude ARRAY Y[]: fftx ffty

Plot Window:

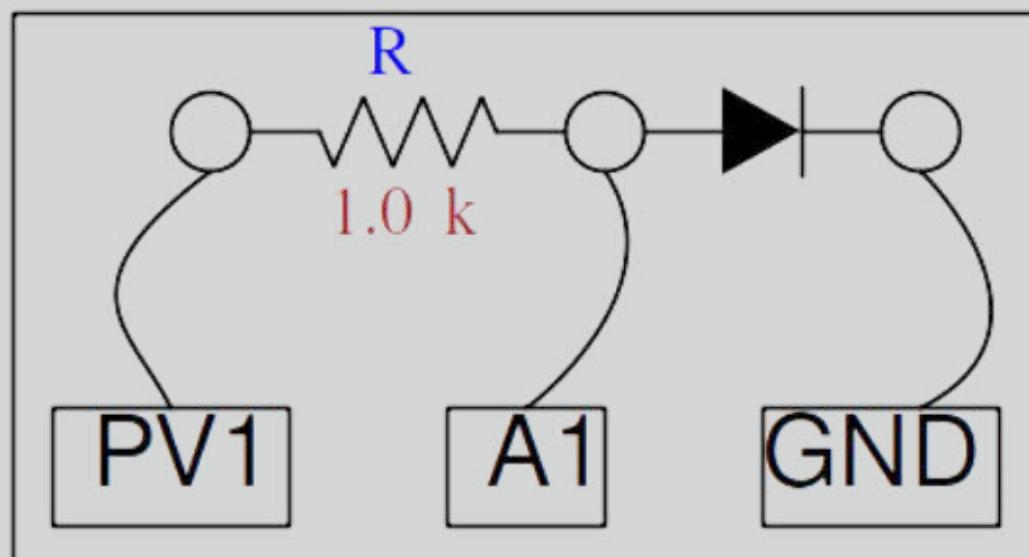
A plot titled "Half wave" shows two oscillating signals. The x-axis ranges from 0.0 to 1.0, and the y-axis ranges from -3 to 3. A blue curve represents a sine wave, and a red curve represents a half-wave rectified sine wave.

Right Sidebar:

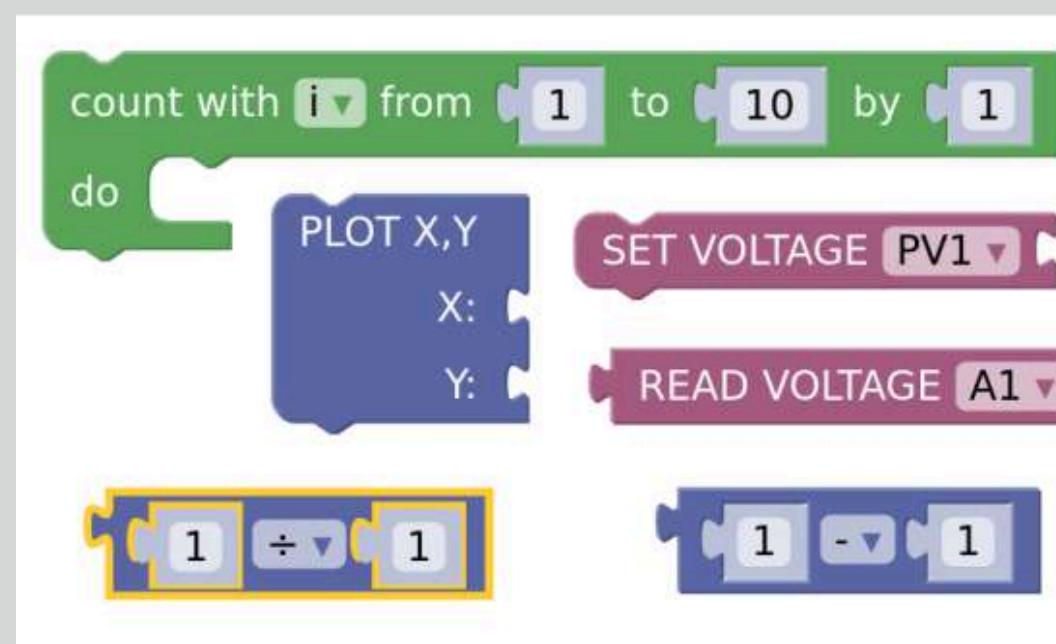
- Stop
- Minimize
- Variables
- Values
- Operators
- Logic
- repeat while do Capture And Plot Chan 2: A2, SAMPLES: 500 TIMEGAP(uS): 5 timestamps data1
- Output
- Save
- Open
- Share
- Edit JavaScript
- Python Code
- Broadcast
- Listen

Diode IV Characteristics : The voltage across PV1 is incremented, and the voltage drop across the diode is measured. Current is calculated as $(PV1 - A1)/R$ using Ohm's law.

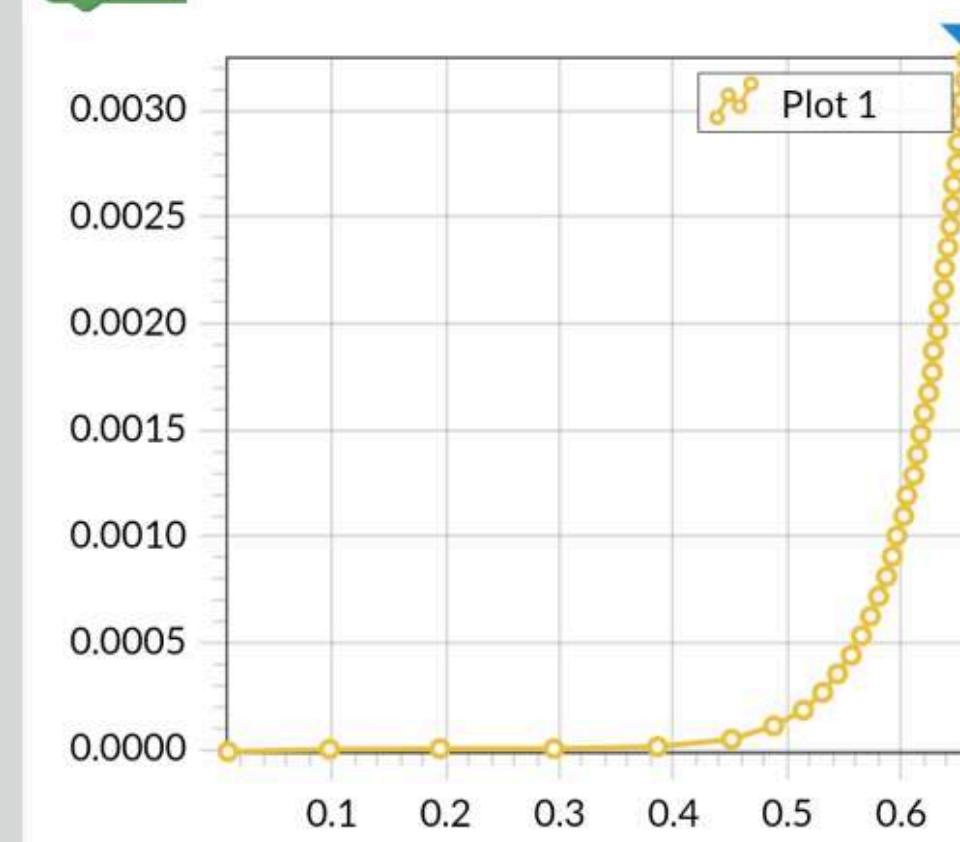
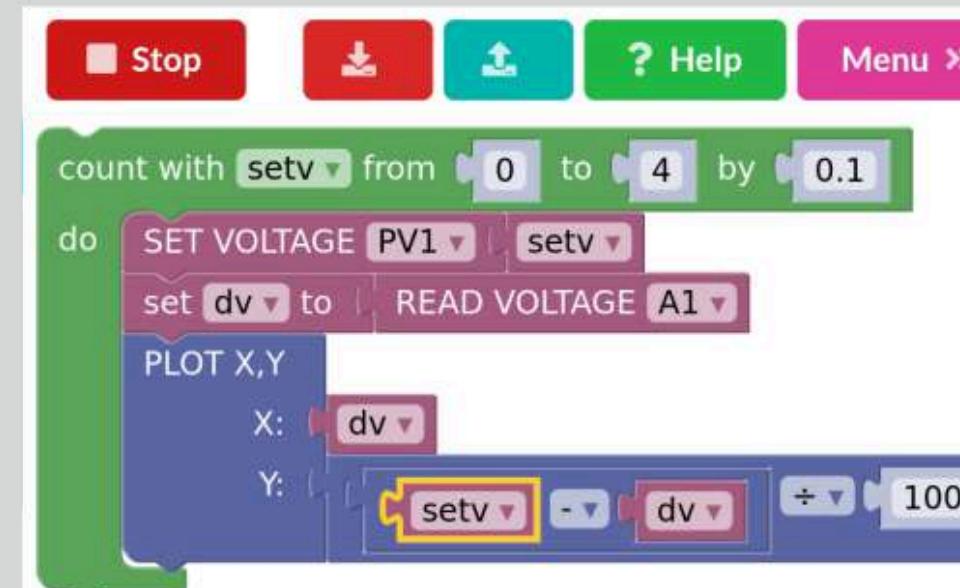
Schematic Diagram



Components required



Program and Results



//Equivalent JavaScript Code

```

var setv, dv;

for (setv = 0; setv <= 4; setv += 0.1) {
  set_voltage('PV1', setv);
  dv = (get_voltage('A1'));
  sleep(0.001); #Settling delay
  plot_xy(dv, (setv - dv) / 1000)
}

```

#Generated Python Code

```

setv = None
dv = None

```

```

def upRange(start, stop, step):
  while start <= stop:
    yield start
    start += abs(step)

```

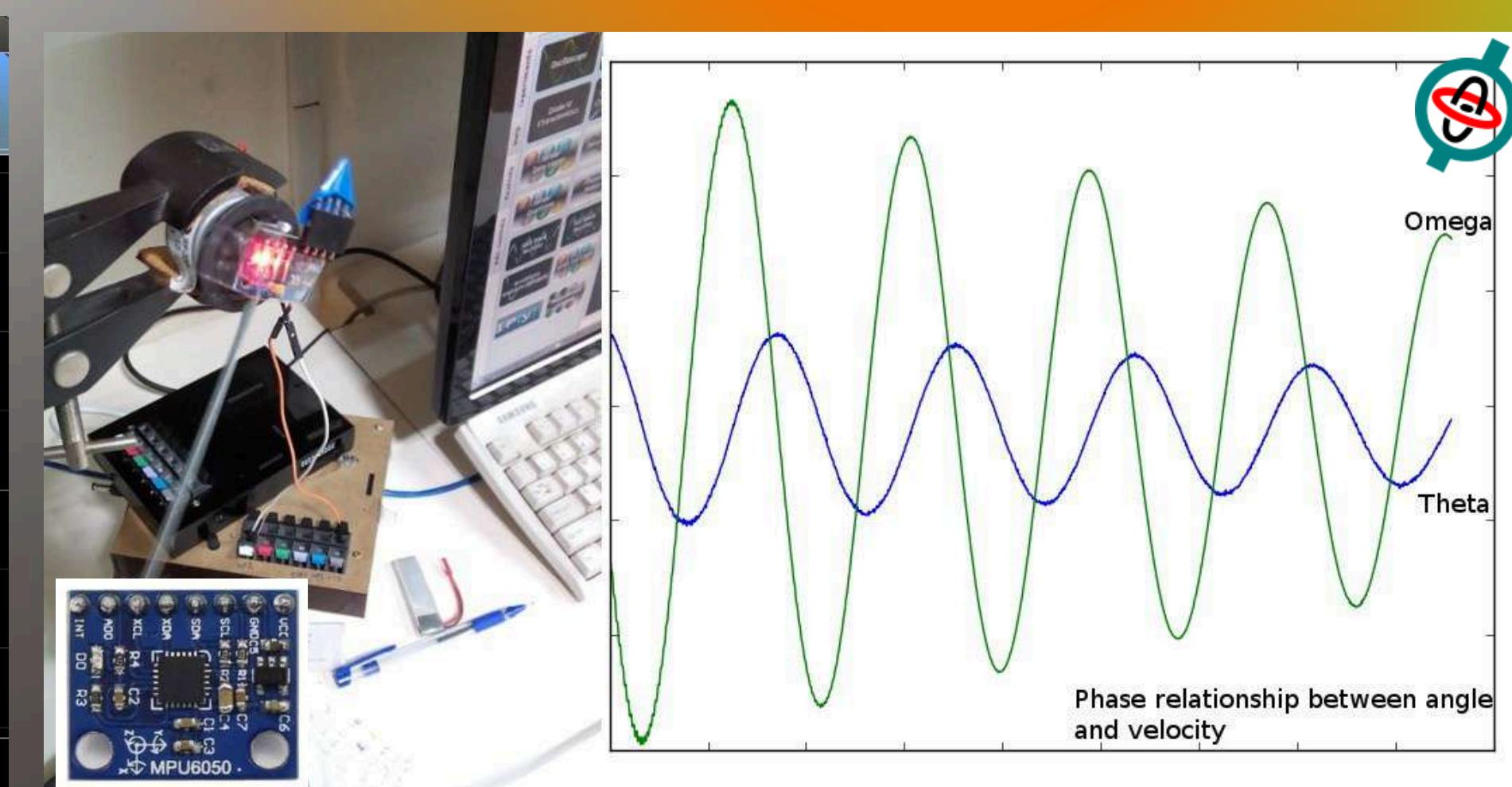
```

for setv in upRange(0, 4, 0.1):
  set_voltage('PV1', setv)
  dv = get_voltage('A1')
  plot_xy(dv, (setv - dv) / 1000)

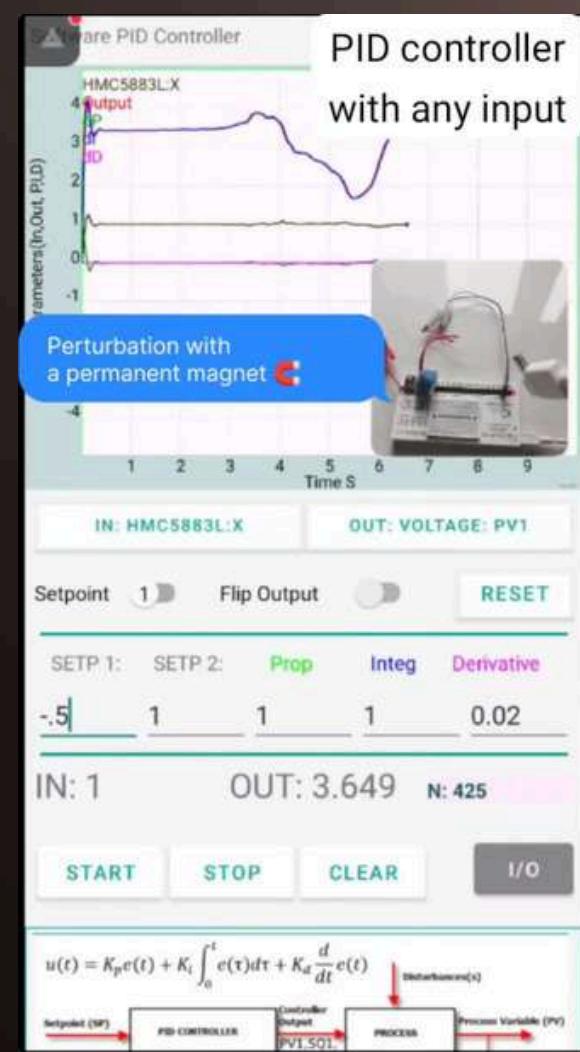
```



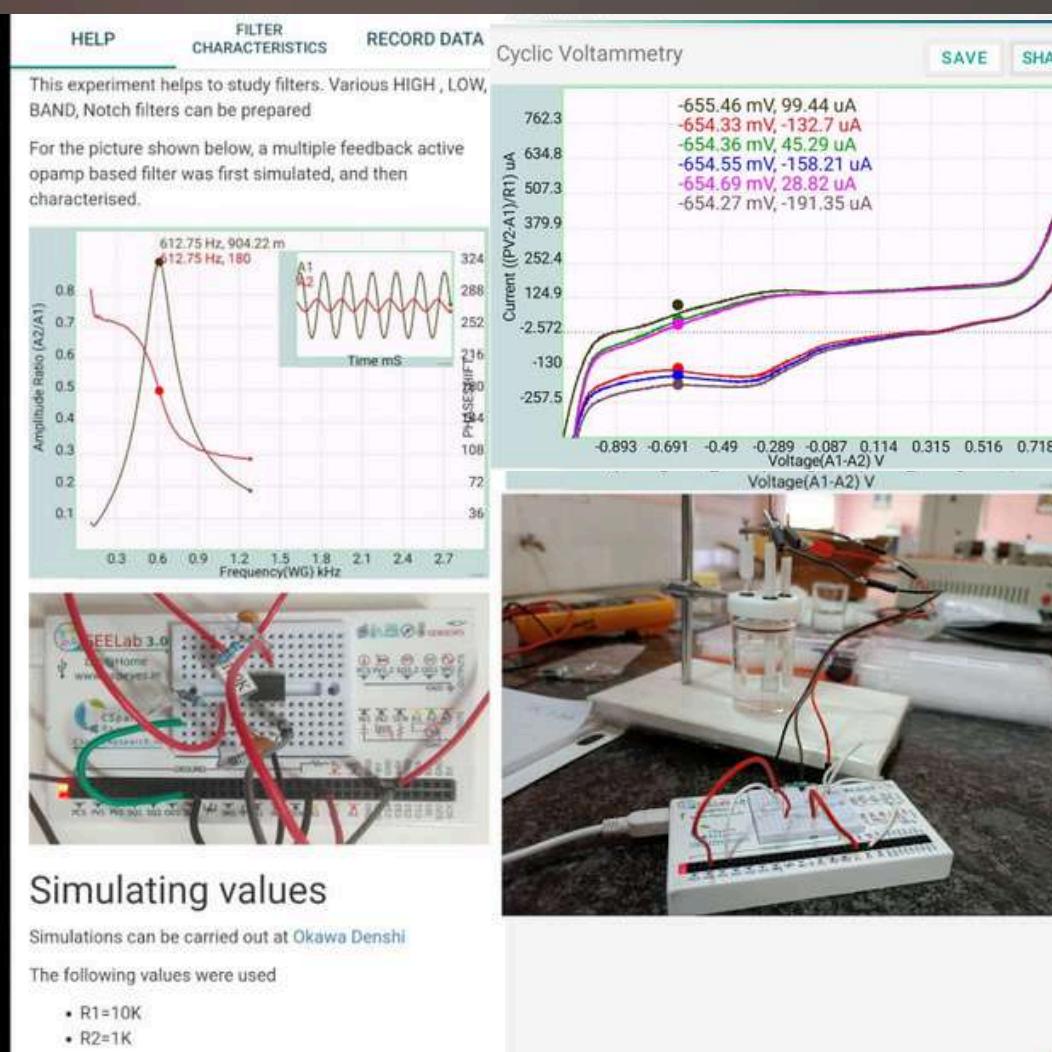
Heart rate detector with the Data logger, an LED, and a phototransistor



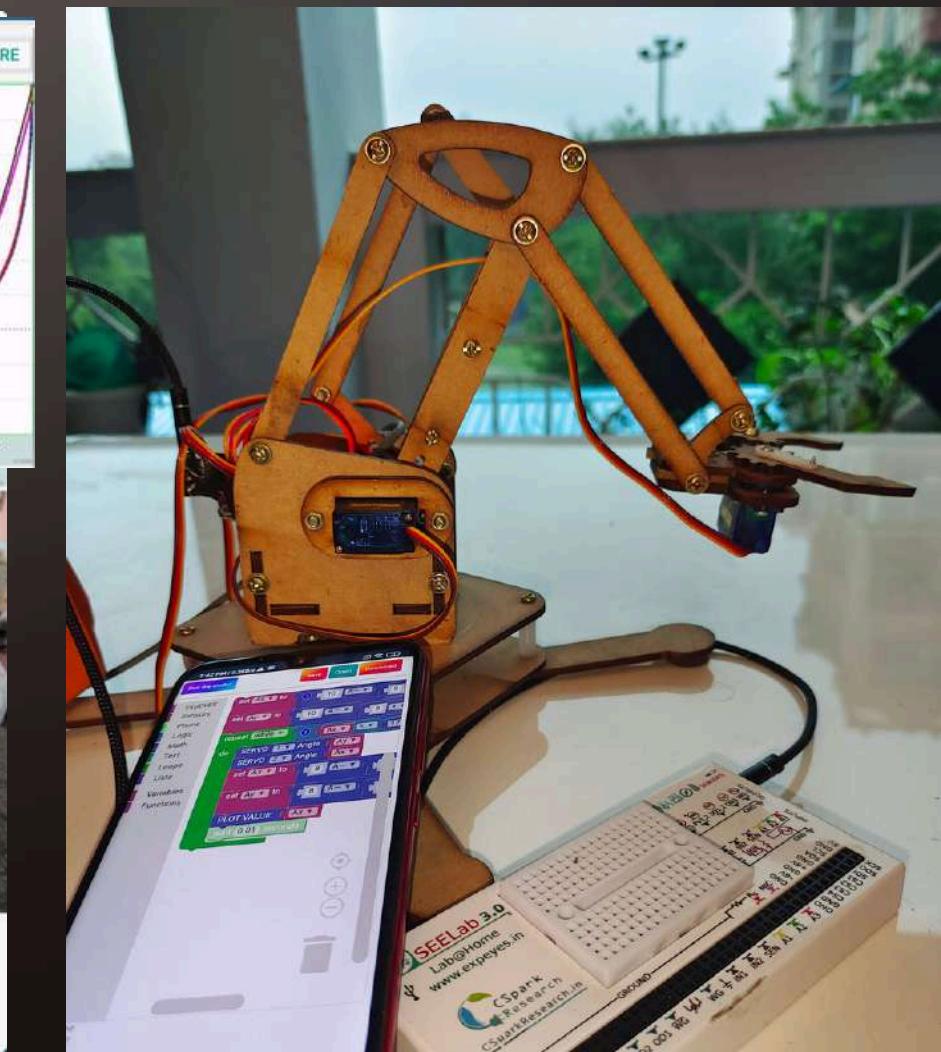
Pendulum oscillations studied with an MPU6050 Accelerometer+Gyroscope



Simulating values



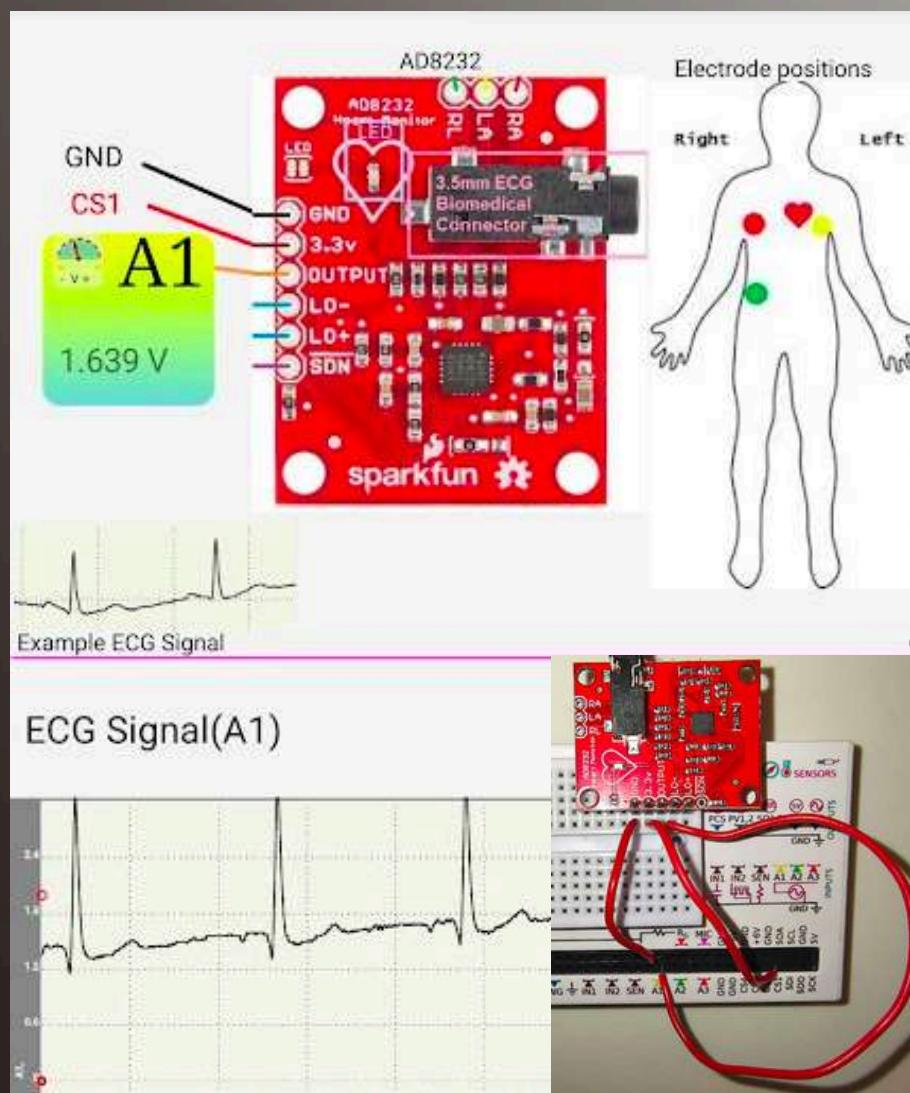
10



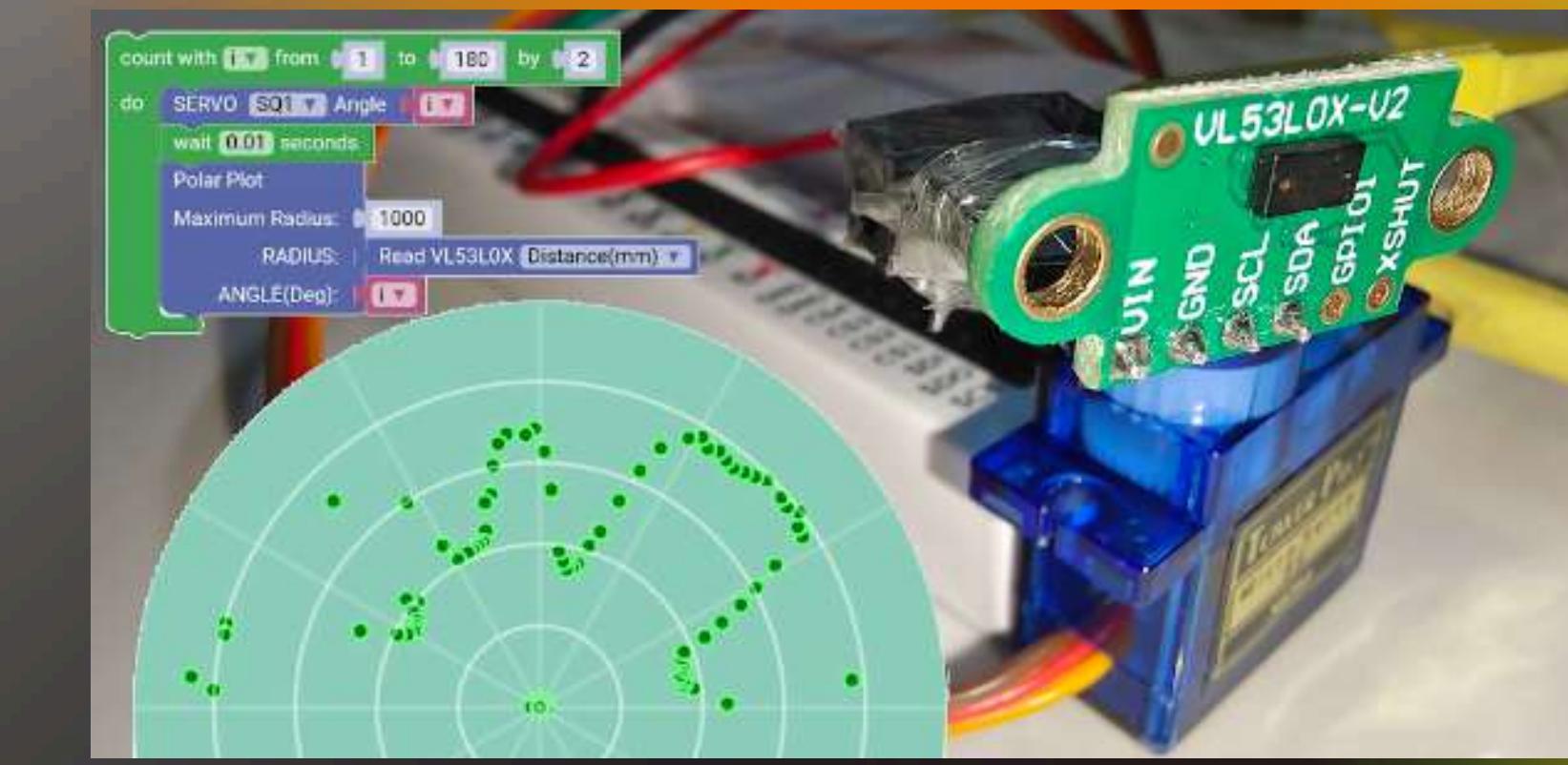
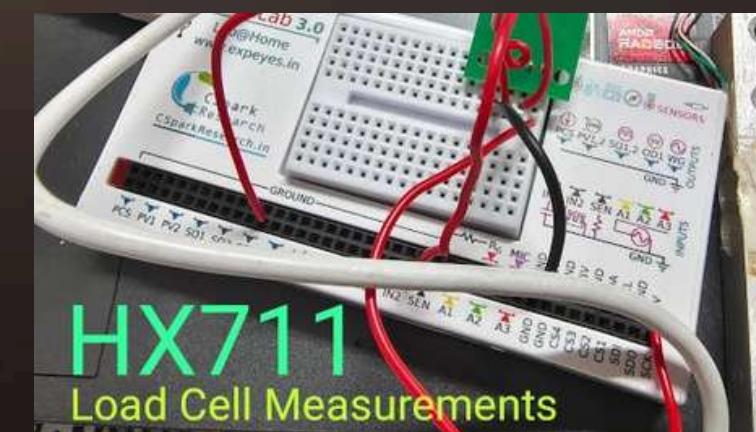
STANDARD ACCESSORIES

Included with the kit

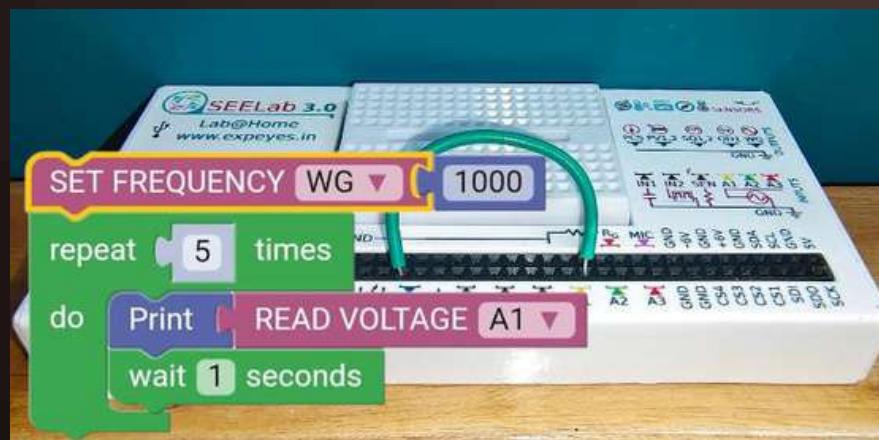
And Many More Activities ...



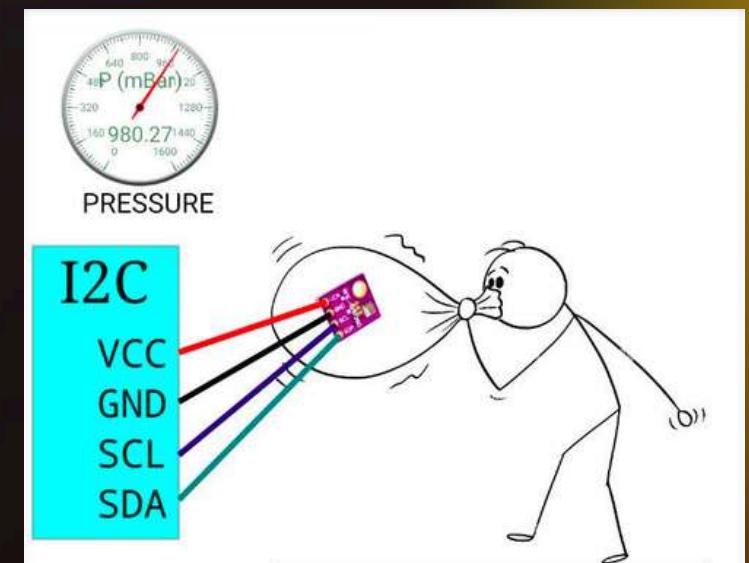
MAGNETIC FIELD READINGS
FROM A 3 AXIS MAGNETOMETER



SCANNING RADAR WITH A DISTANCE SENSOR
AND A SERVO MOTOR

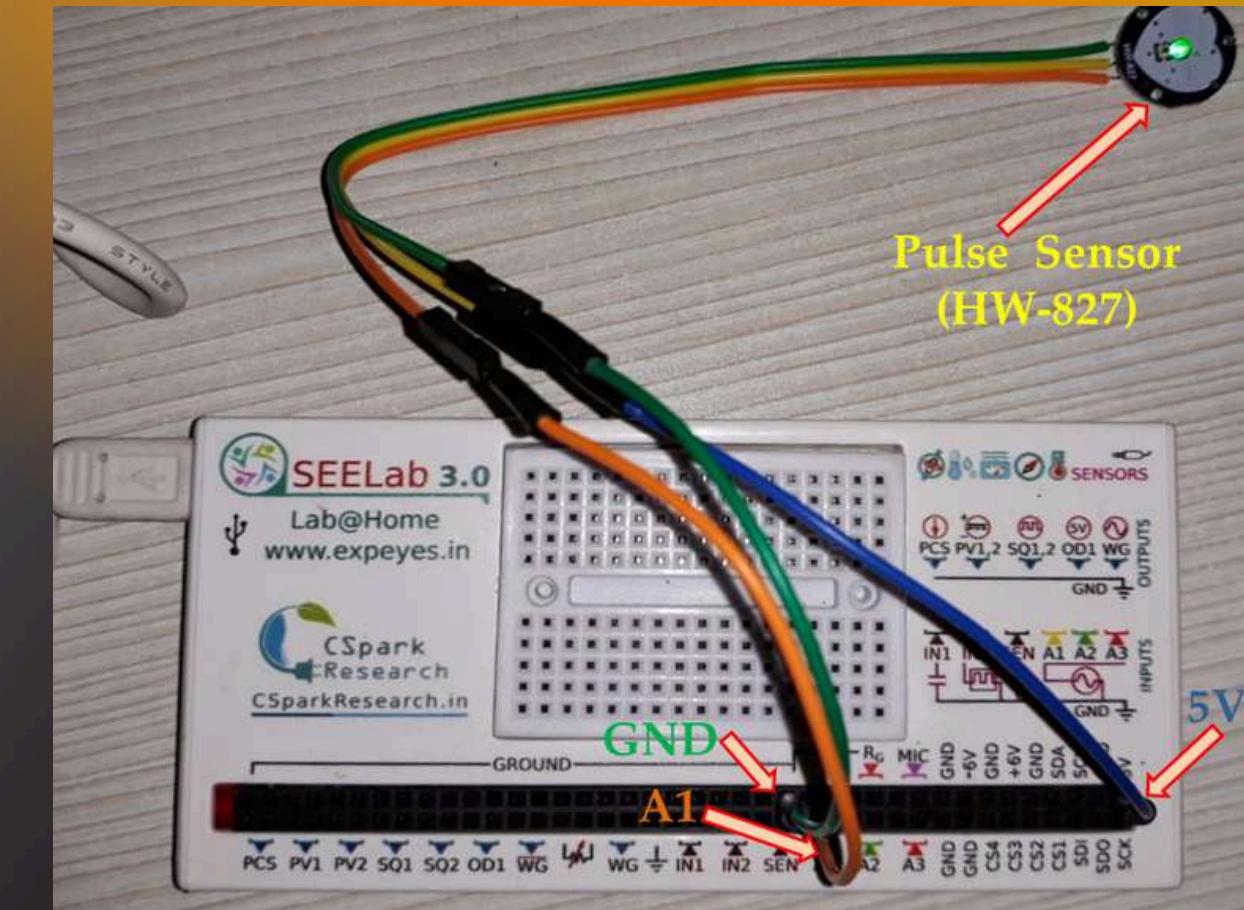
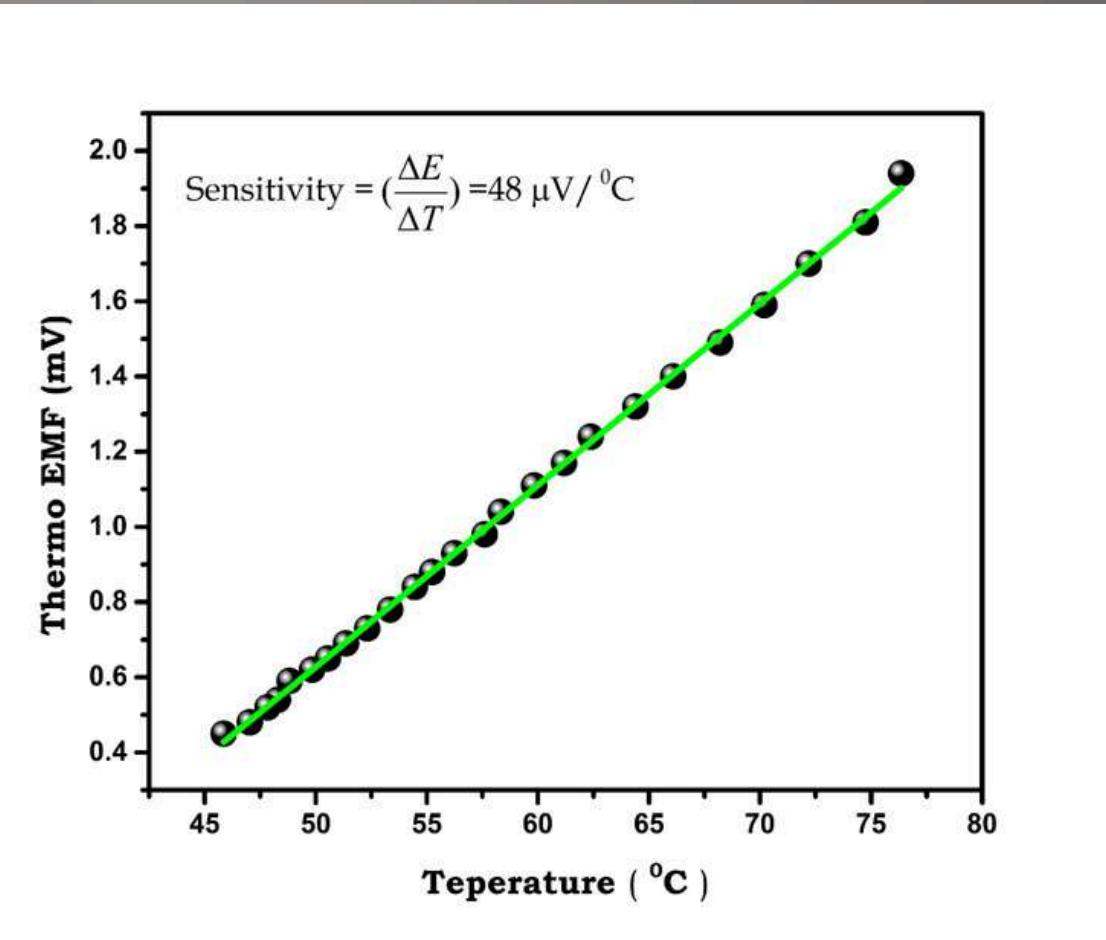
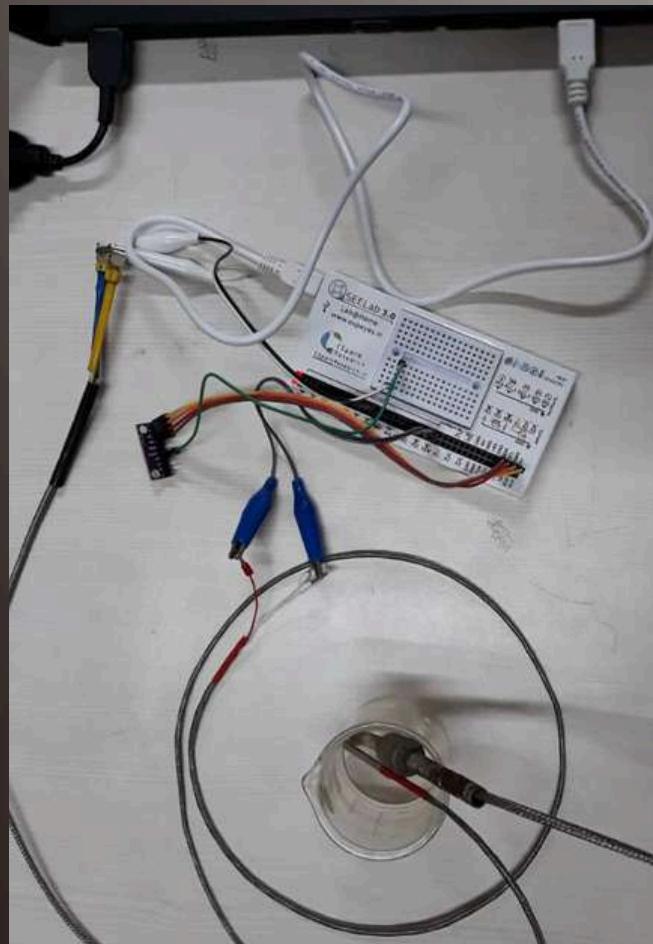


PLUG AND PLAY I2C SENSORS

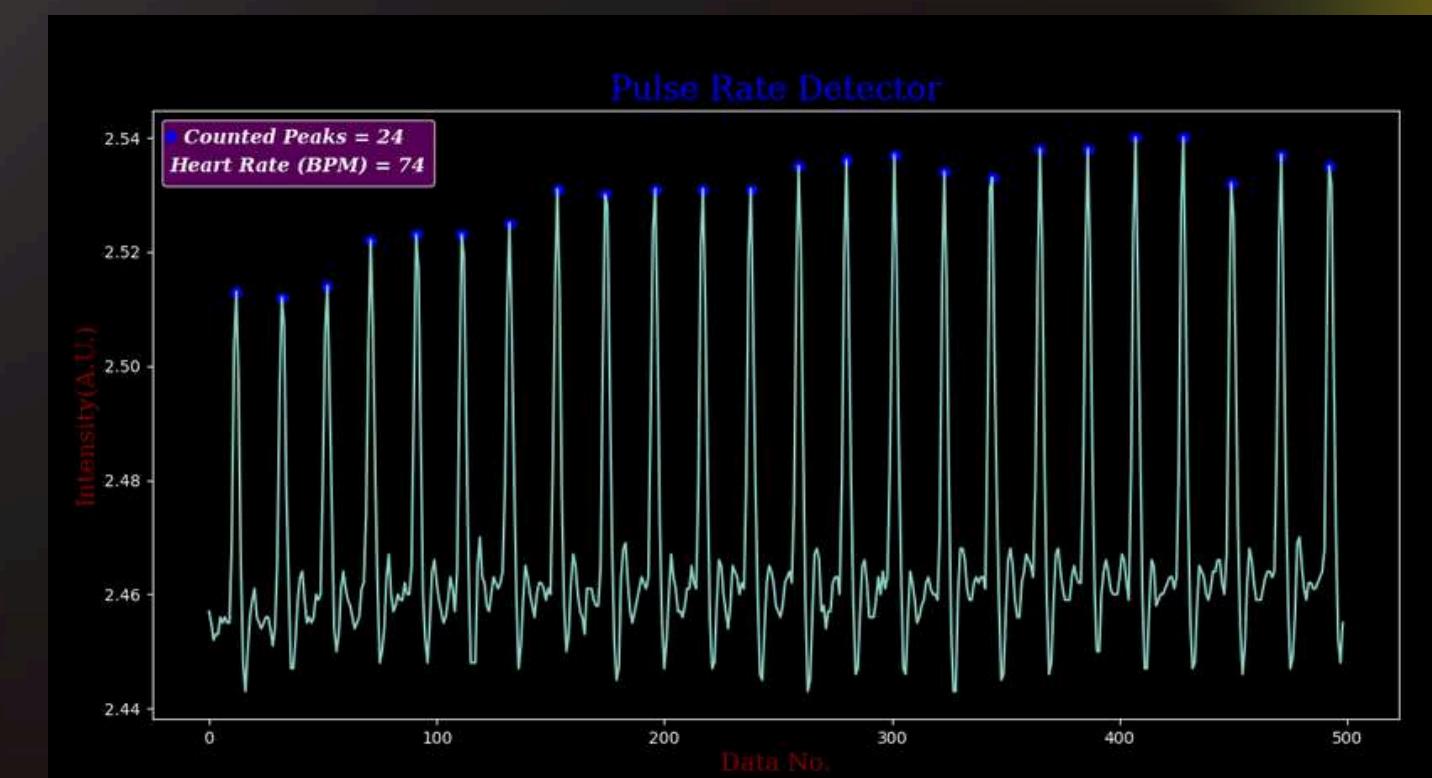
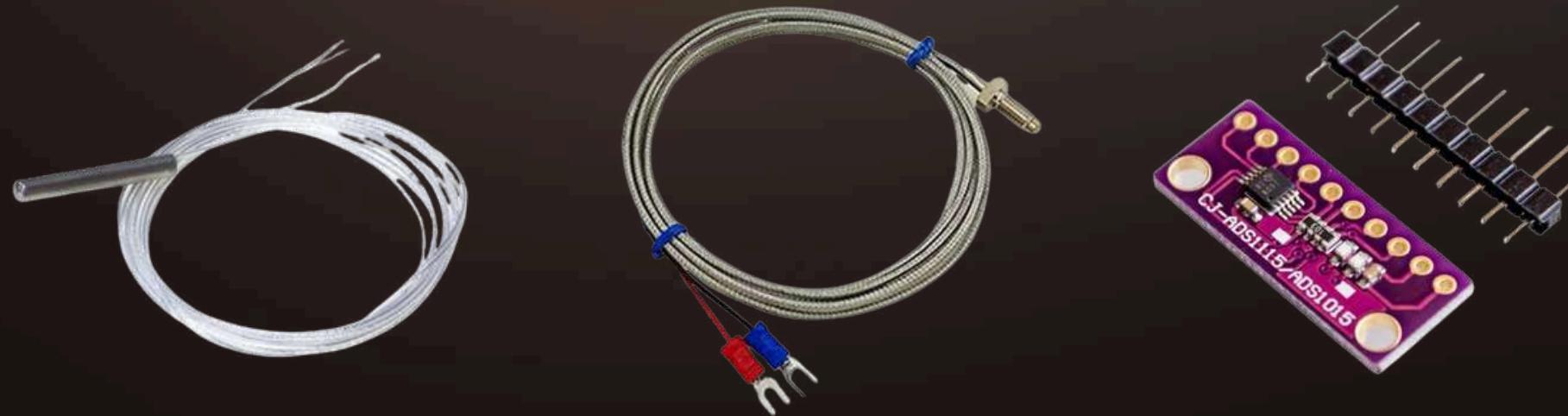


PRESSURE SENSOR

Thermoelectric measurements by Dr Ujjwal, NSHM Academy



Add-Ons :
ADS1115 16-bit ADC , PT1000 temperature sensor.

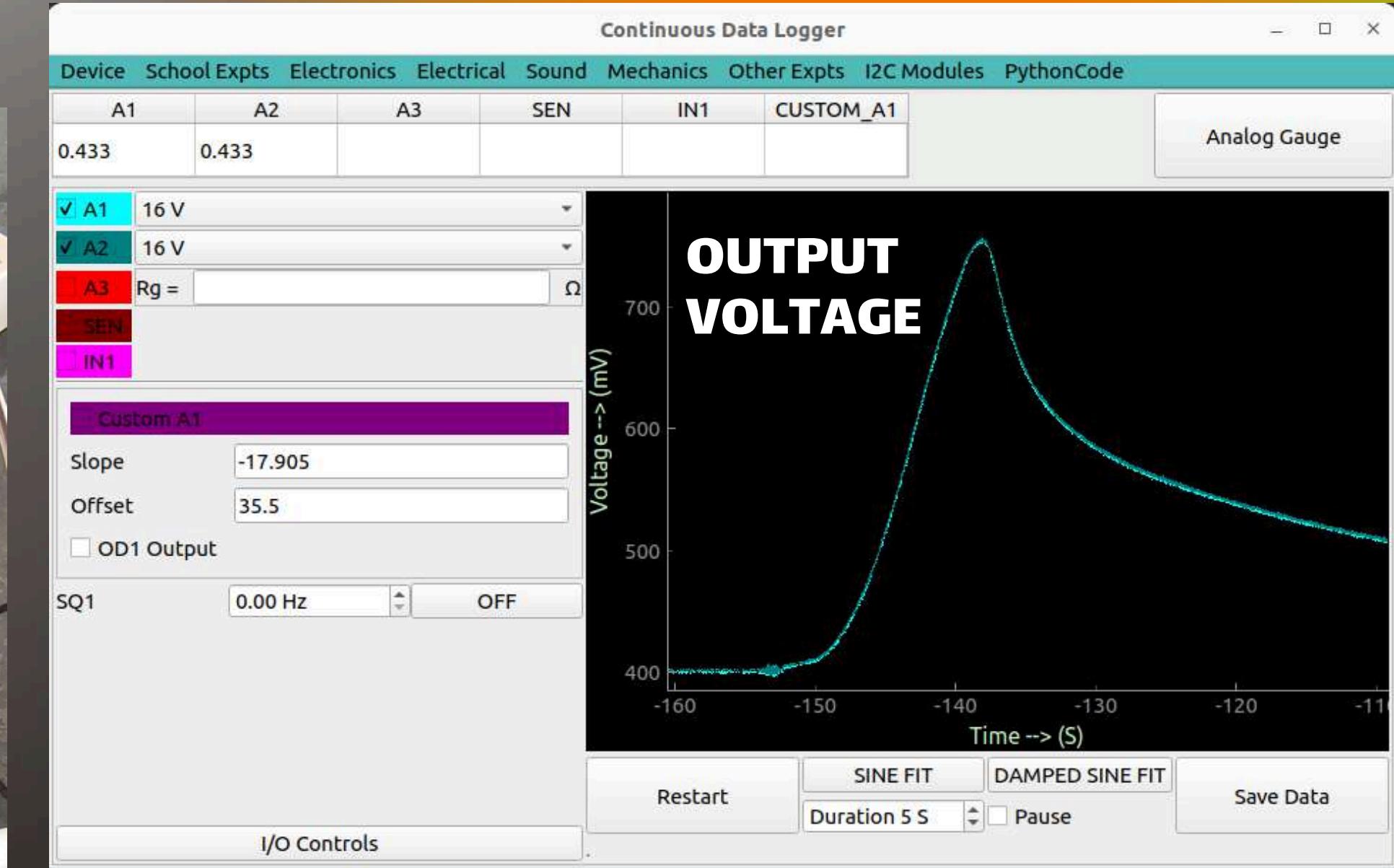
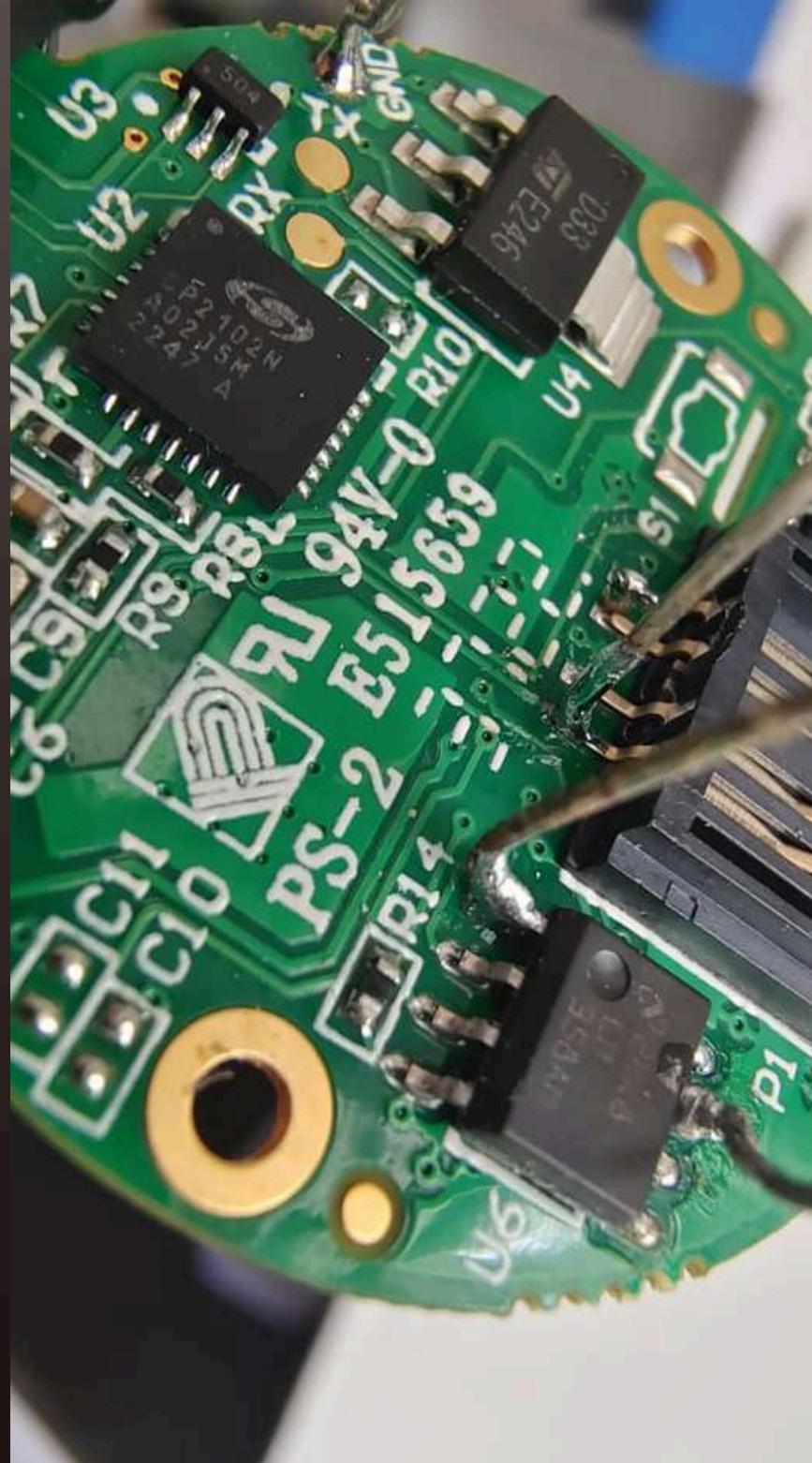


Community Contributions: Publications

CSpark Research

Title	Journal	Author(s)			
EXPLORING THE TRANSIENT PHENOMENA OF ELECTROMAGNETIC INDUCTION	HBCSE - TIFR	Amit Dhakulkar and Nagarjuna G	INNOVATIVE APPROACH FOR SOLAR RADIATION MEASUREMENT AND DATA ACQUISITION USING expEYES	http://dx.doi.org/10.29369/ijrbat.2015.03.II.0053	V S Rahangadale and A K Mittra
Evaluation of Boltzmann's Constant : Revisit using interfaced data analysis	Physics Education 32(3):1-5 · September 2016	Vandana Luthra et al	Determination of the band gap of germanium and silicon using ExpEYES-17 kit	Physics Education Phys. Educ. 57 025026	Subhrajyoti Biswas
Analysis of Transient Response of First & Second Order System using ExpEYES	International Journal of Electrical Electronics and Computer Systems (IJEECS)	Omkar S. Vaidya et al.	Study of Fourier series of user defined waveforms using ExpEYES-17 kit	Phys. Educ. 57 035008	Subhrajyoti Biswas
Optical Sensor Using ExpEyes Junior Kit	International Journal of Innovations in Engineering and Technology (IJIET)	Trilochan Patra	Study of magnet fall through conducting pipes using a data logger	SN Applied Sciences(https://doi.org/10.1007/s42452-019-1086-z)	Abdul Kareem Thottoli et al.
AUDIO FREQUENCY ANALYZER USING EXPYES AND RASPBERRY PI	3rd international conference on recent innovations in science engineering and management	Haldankar et al.	Construction and remote demonstration of an inexpensive but efficient linear differential variable transformer (LVDT) for physics or electronics teaching during COVID-19 pandemic	Physics Education, Volume 58, Number 1(10.1088/1361-6552/ac93de)	Arijit Roy et al 2023 Phys. Educ. 58 015007
A Low Cost Open Source Hardware Tool for Integrated Learning Experience in Laboratories	Journal of engineering education transformations DOI: 10.16920/jeet/2015/v0i0/59677	A. B. Raju et al.	Microcontroller based study of diode thermometers for online demonstration of undergraduate laboratory classes in COVID-19 lockdown	Physics Education, Volume 57, Number 4 (10.1088/1361-6552/ac563f)	Subhrajyoti Biswas and Durjoy Roy 2022

Studying a low-cost glucometer (Amperometry)



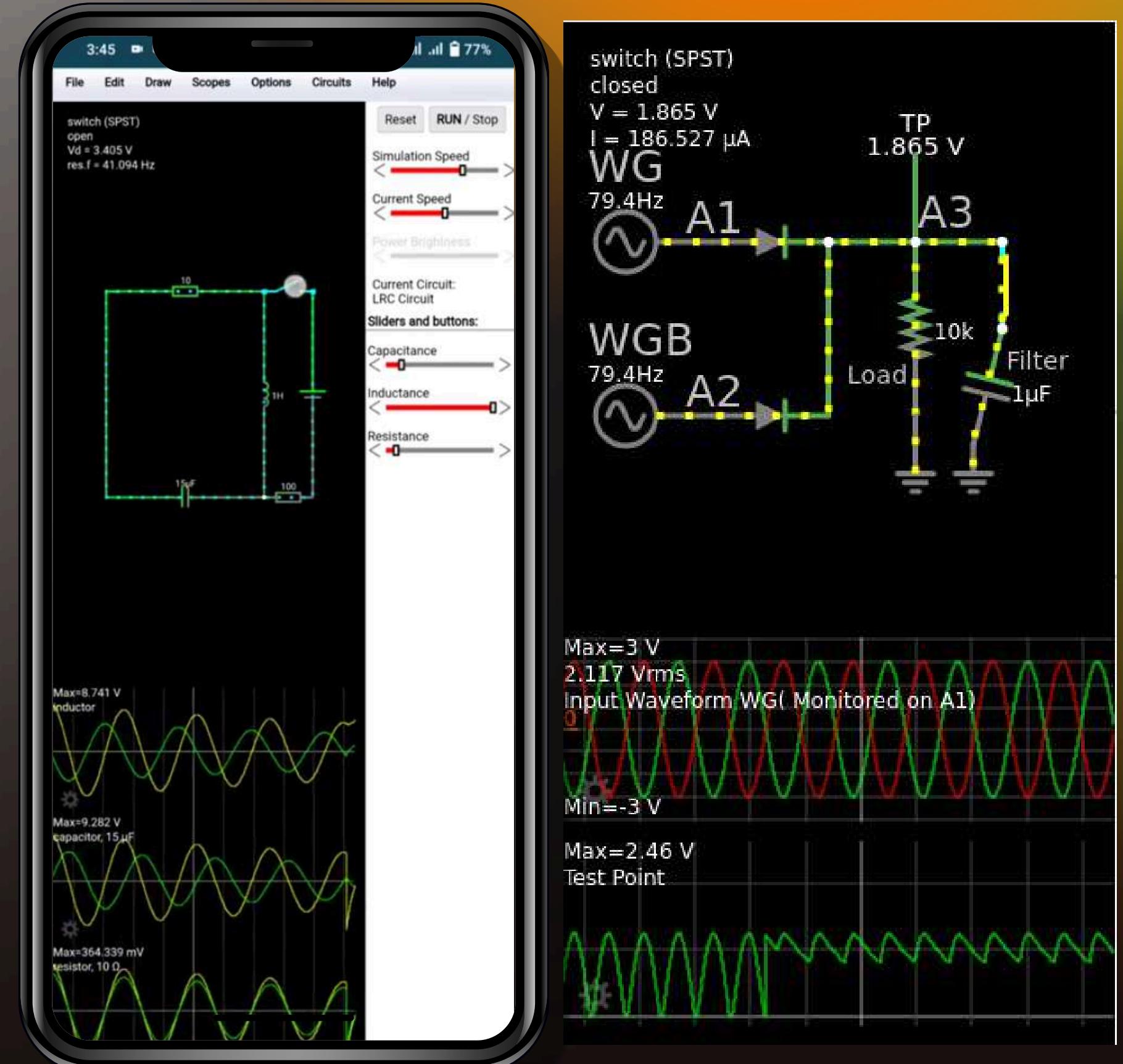
Op-Amp outputs are monitored with A1, A2 voltmeters and plotted to study what the meter sees!

This device can be reprogrammed! Make your own enzymatic sensors!



Circuit Simulator: Create and visualize circuits. Over a hundred examples

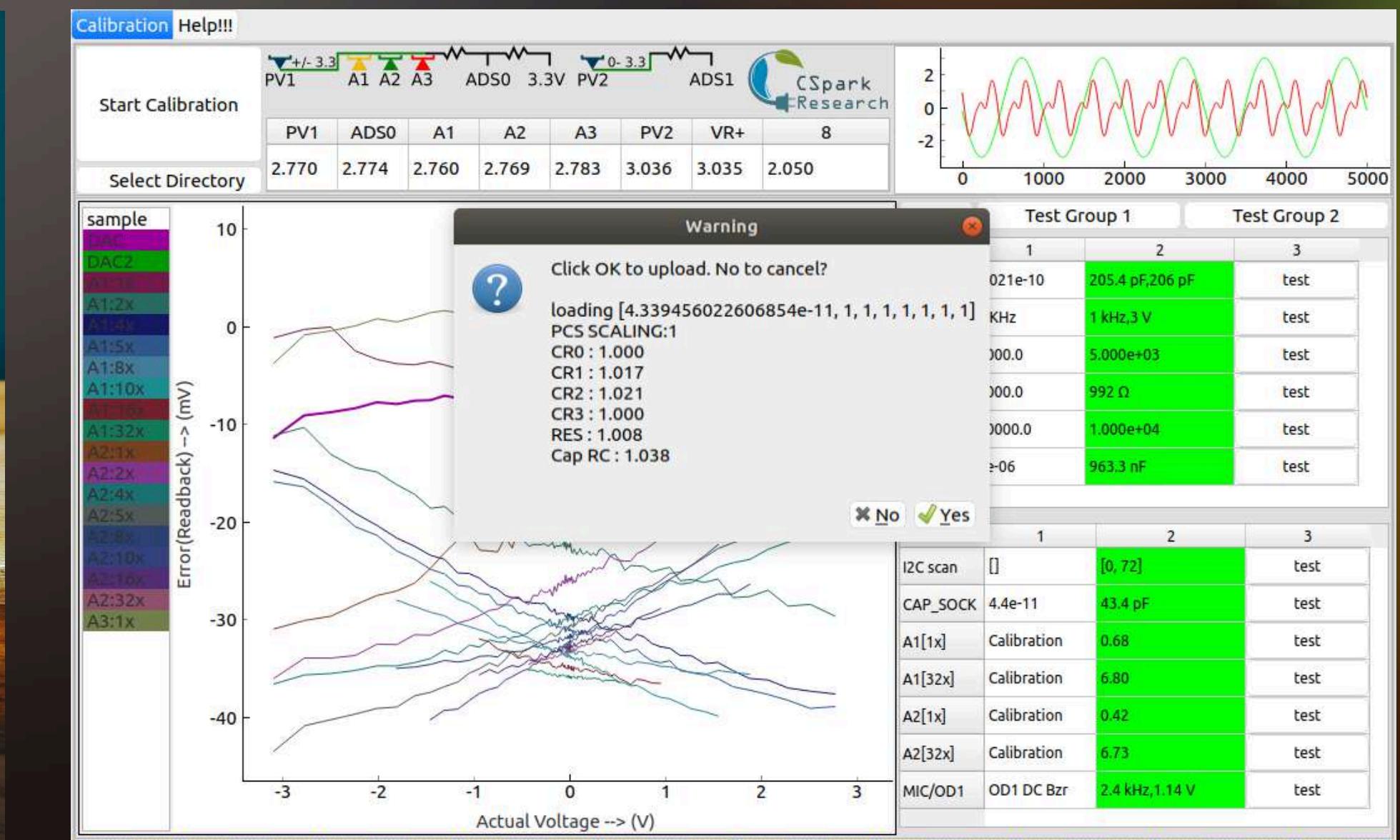
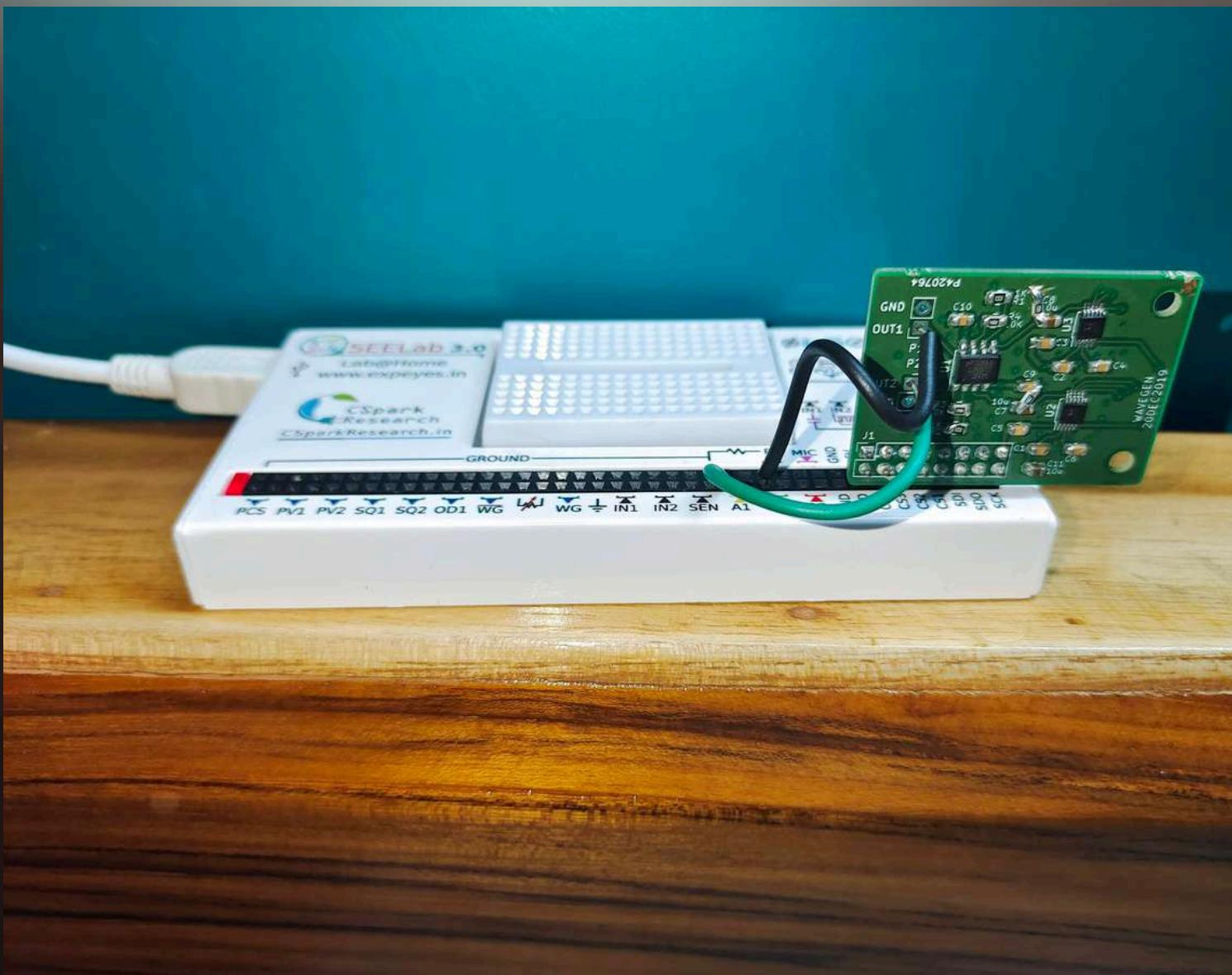
- Built into the desktop application
- Create circuits with a range of predefined components, and visualize current flows, phase differences, and even reflectance
- Also integrated into the mobile app with several extra examples specific to SEE Lab3.
- Most common circuits are readily available as reference for wiring up for physical studies.

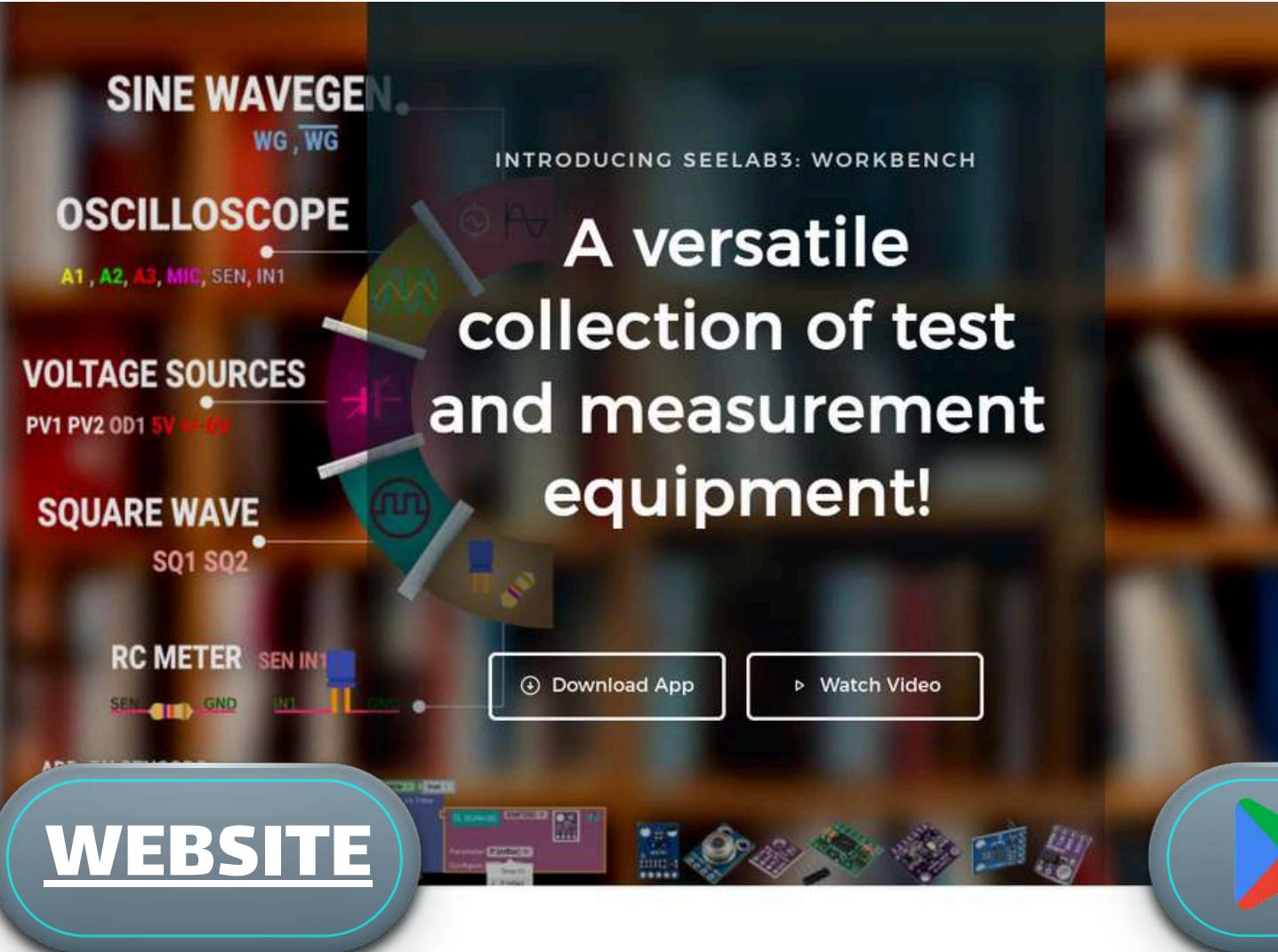


Manufacturing, Testing, and Calibration



- State of the art Electronics Pick and Place Assembly
- Automatic optical inspection for soldering perfection
- Calibrated and tested for accuracy





WEBSITE

<https://csparkresearch.in/seelab3>



Phone +91-8851100290
csparkresearch@gmail.com

INSTAGRAM

<https://instagram.com/csparkresearch>



Designed and manufactured in India by



- ✓ **Analog Measurements:** Voltages, Oscilloscope calls etc
- ✓ Voltage Measurement
- ✓ Capture calls
- ✓ Capture configuration such as trigger, select_range etc
- ✓ Code Examples
- ✓ **Analog Output:** Set Voltages
- ✓ PV1, PV2
- ✓ **Waveform Generators:** configure sine, triangle, square wave outputs
- ✓ sine wave frequency, amplitude, shape configuration
- ✓ square wave setting
- ✓ Digital I/O

