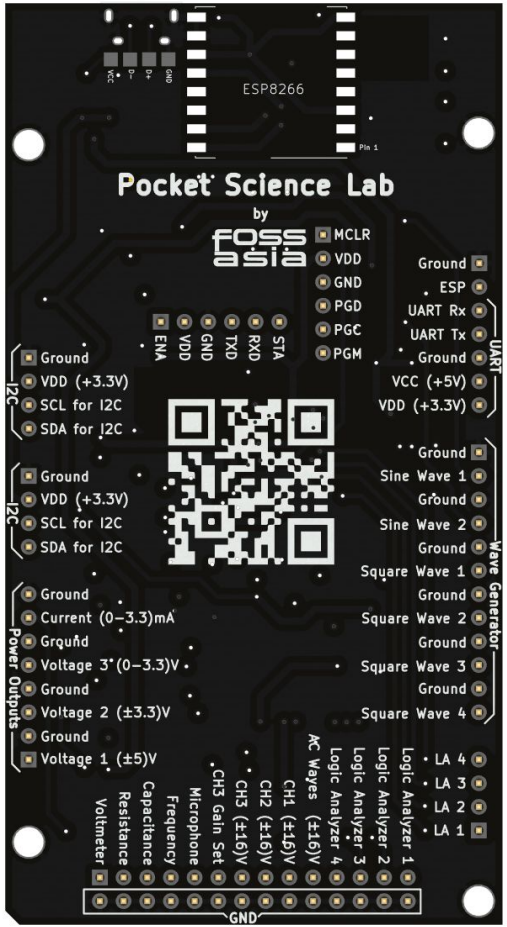
PSLab

Pocket Science Lab from Development to Production

PSLab.io

Mario Behling



PSLab - How to use it?

- Useful control and measurement tools
- Integrated components can be used by pins
- Functionalities can be accessed through:
  - PSLab Desktop app
  - PSLab Android app
  - Your own apps

What can it do

It can function as a..

Oscilloscope

Multimeter

Logic Analyzer

Wave Generator

Power Source

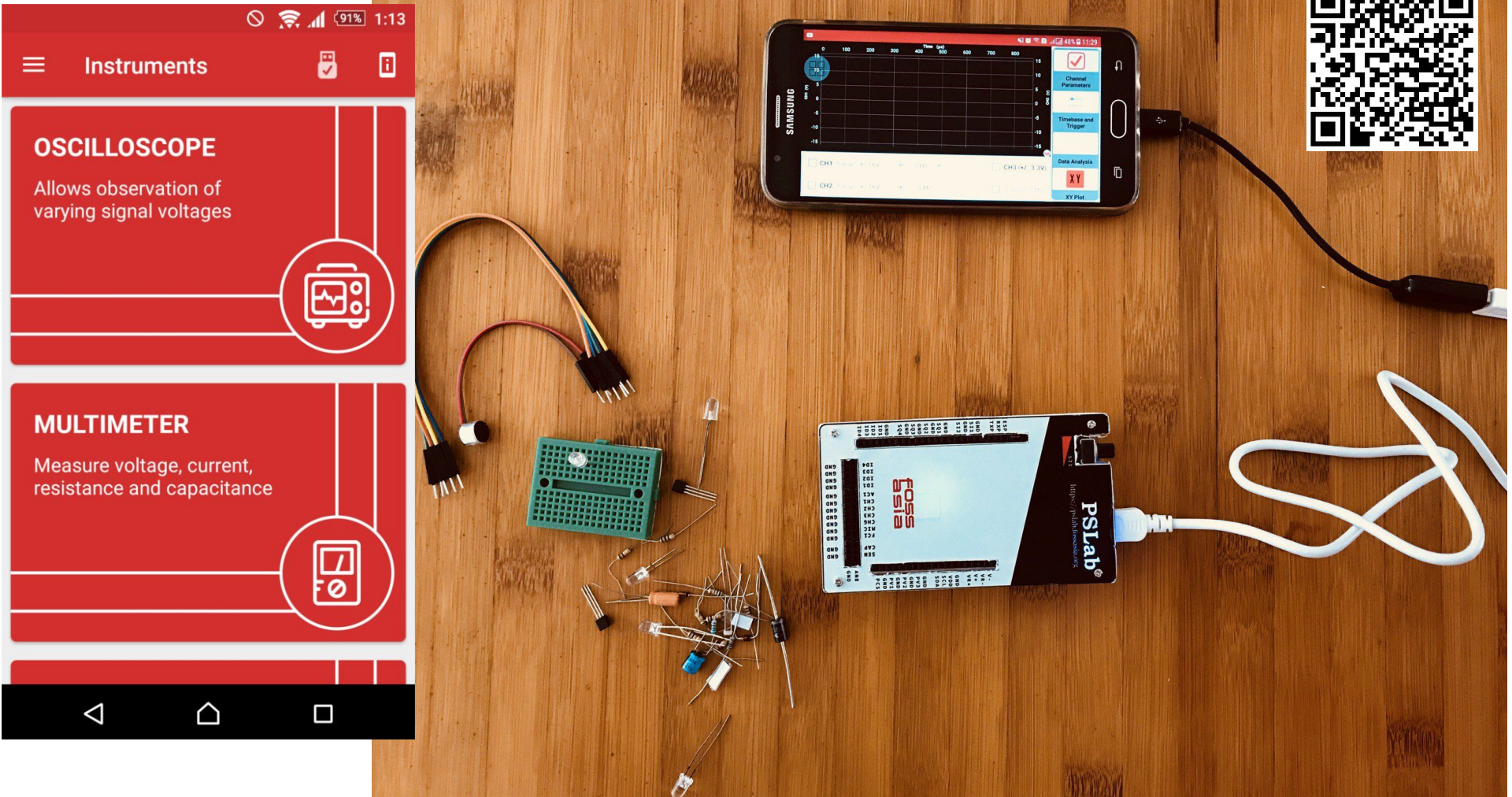
Accelerometer

Barometer

Compass

Sensors

Luxmeter


91% 1:13
Instruments
OSCILLOSCOPE
Allows observation of varying signal voltages
MULTIMETER
Measure voltage, current, resistance and capacitance
SAMSUNG
Channel Parameters
Timebase and Trigger
Data Analysis
XY Plot
foss asia
PSLab

Hardware Specifications

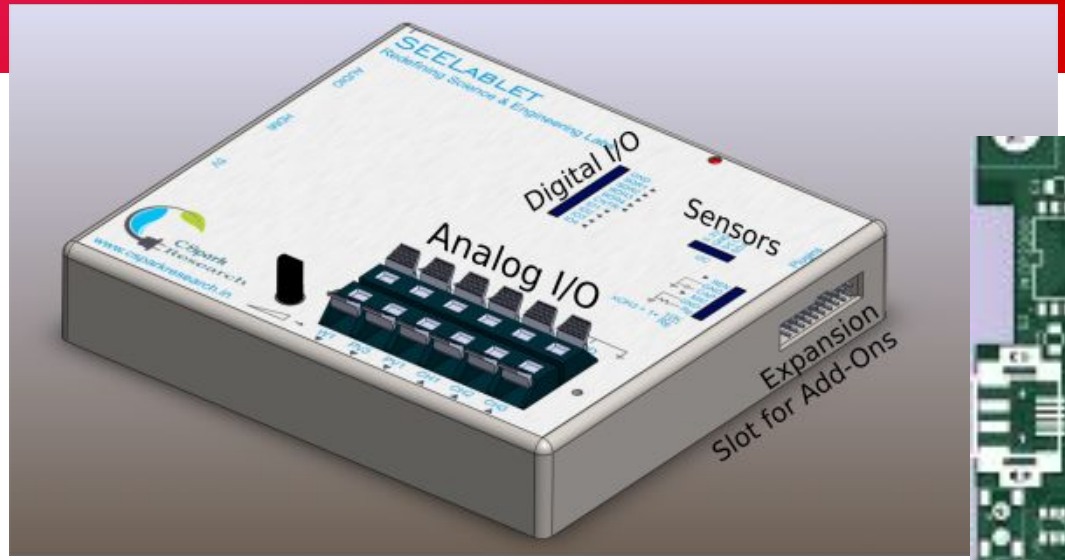
- 4 x Channel Oscilloscope (2MSPS)
- 12 bit Voltmeter (Input +/-10 megavolt to +/-16 Volt)
- 12 bit Programmable voltage sources → +3V, ±3.3V, ±5V
- 12 bit Programmable current source → 3.3 milliamps (mA)
- 4 x Channel Logic Analyzer (4 MHz)
- 2 x Sine wave generators (10 Hz to 5 KHz)
- 4 x PWM generators (8 MHz)
- Capacitance Measurement (pF to uF)
- Resistance Measurement (mΩ to MΩ)
- I2C, SPI, UART data buses (Accelerometer, Gyroscopes …)
- Frequency Counter (16 MHz)

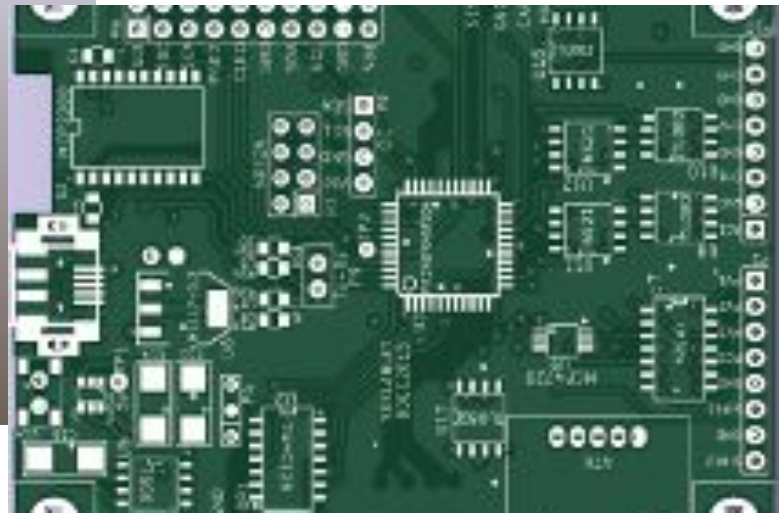
Waveform Generators

- SI1: 5 Hz – 5 KHz arbitrary waveform generator. Manual amplitude control up to +/-3 Volts
- SI2: 5 Hz – 5 KHz arbitrary waveform generator. Amplitude of +/-3 Volts. Attainable via software
- SQx: There are four phase correlated PWM outputs with maximum frequency 32 MHz, 15 nano second duty cycle, and phase difference control.


Features:
• USB Powered
• ADC and DAC with 12 bit resolution
• Time interval measurements with microsecond resolution
• Programmable square wave generator
• Fundamental low frequency LCRO and frequency counter
• Data
and Graphics using Python Language
LINETEK

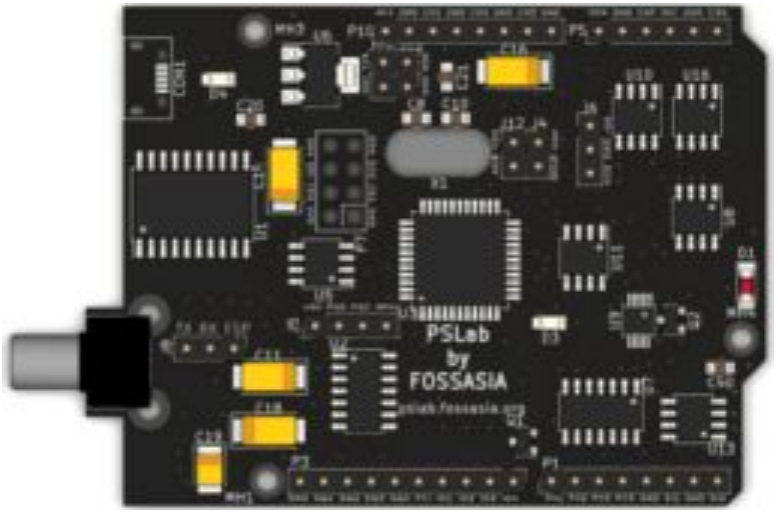
Original SEELABLET





Project development starts with KiCad in 2014

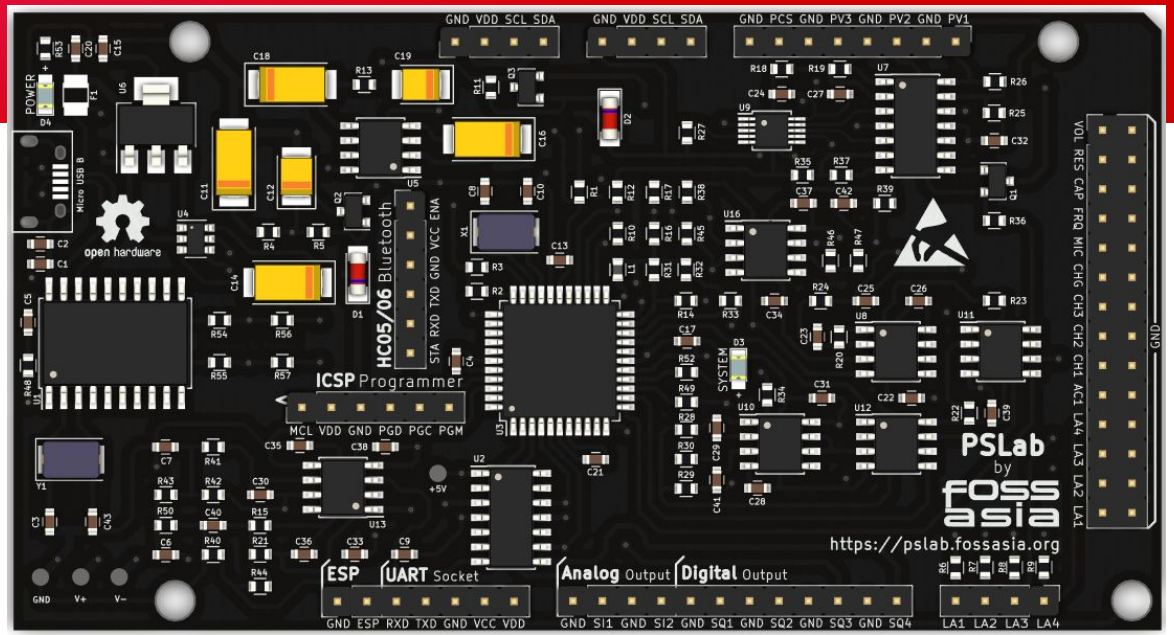
First Open Hardware PSLab Version in Arduino Uno Form Factor







Form Factor Arduino Mega



Assembly optimized version having components mounted only on top side

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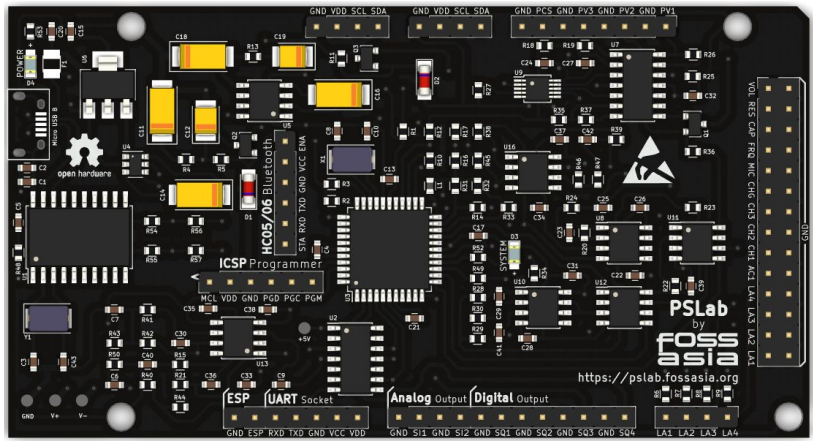
Pocket Science Lab with Form Factor Arduino Mega



- Supports Bluetooth module and wifi module ESP8266
- Last version many small enhancements for newbies, especially the backside with description and QR code
- 4 more digital pins to add one more sensor

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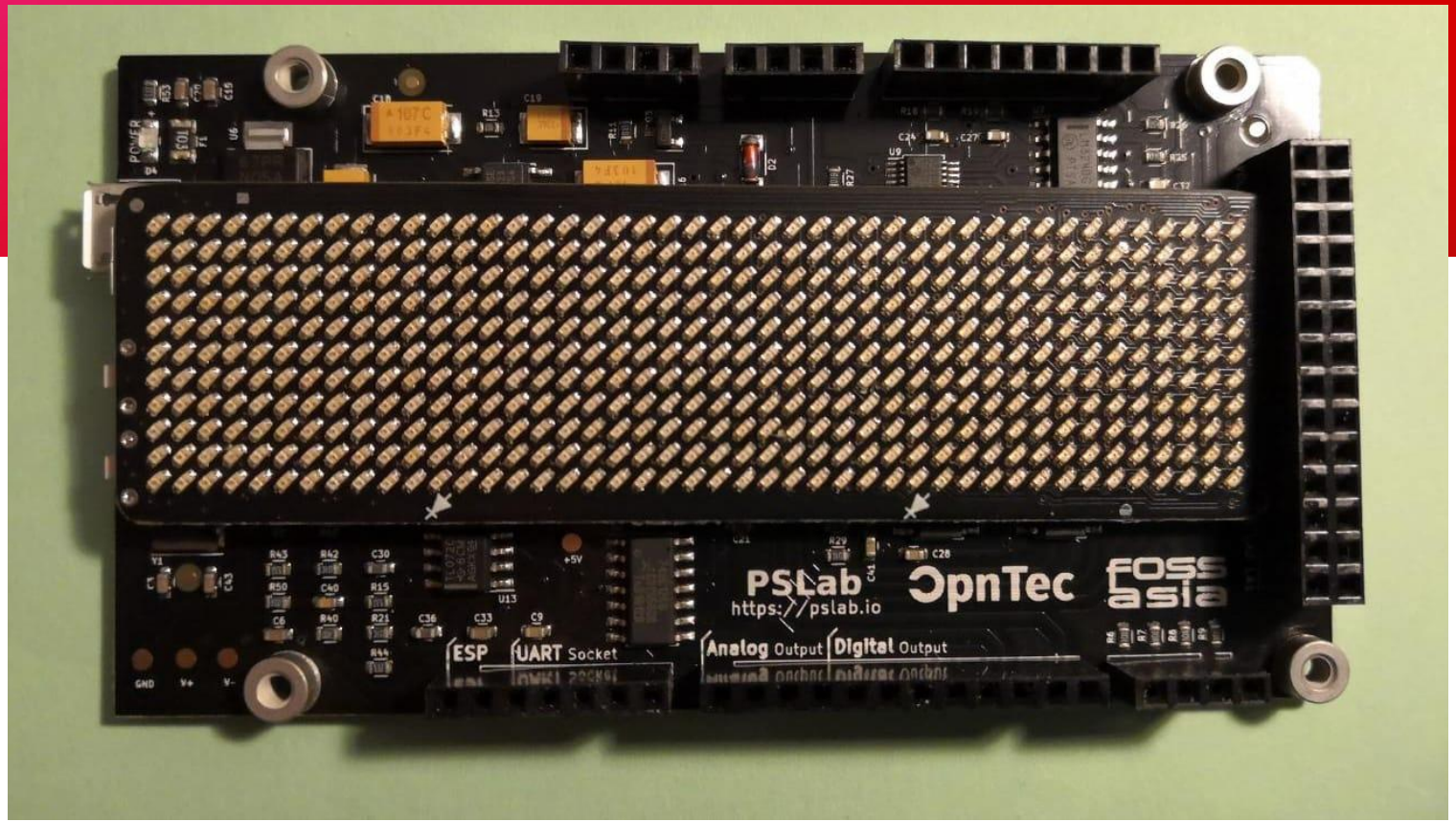
POWER
PSLab
https://pslab.io
OpnTec
foss asia
ESP UART Socket
Analog Output
Digital Output
GND
V+
V-
+5V

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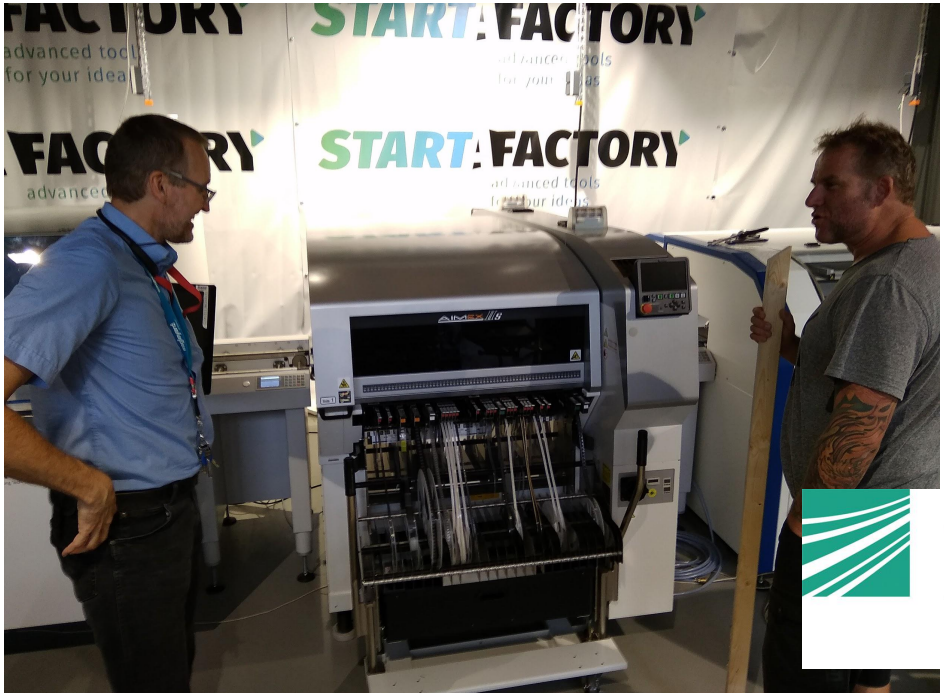
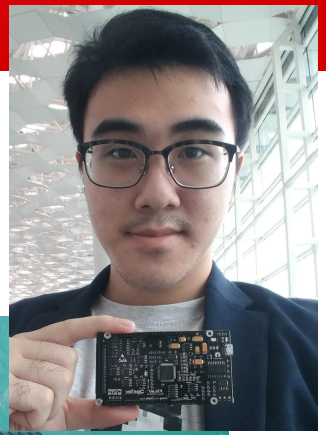
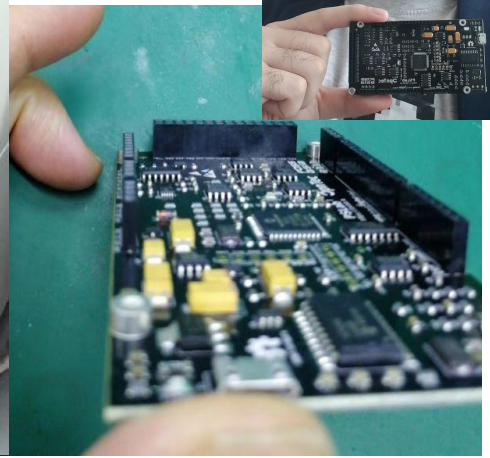
Producing batches in China/Shenzhen and Fraunhofer IZM in Germany Berlin

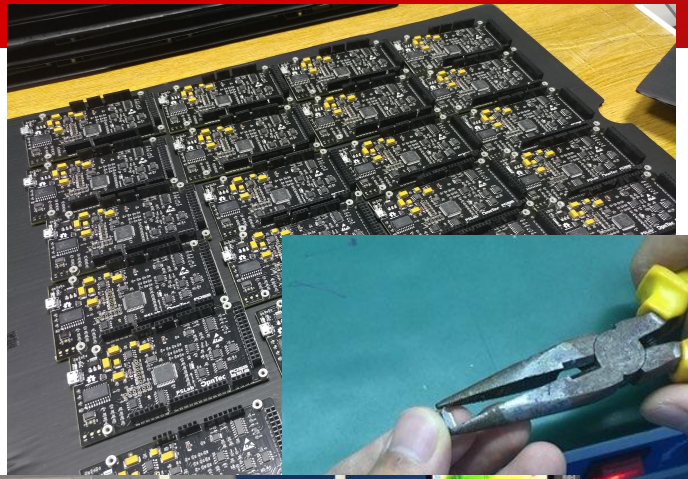


Fraunhofer
IZM

Producing batches in China/Shenzhen and Fraunhofer IZM in Germany Berlin







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Hardware Production - Lessons Learned

- ❏ Creating a BOM and Coordinating with Producers is a Full-Time job
- ❏ There are parts in reels, tubes etc. - prices are different
- ❏ Best is to have someone who can speak Mandarin
- ❏ Expect Components to Become Unavailable
- ❏ Understand offers of “Remanufactured”
- ❏ Micro USB headers didn’t fit into the PCB
- ❏ The female pin headers are not soldered straight
- ❏ Some PSLabs didn’t work due to reflashing problem
- ❏ Expect Faulty Parts

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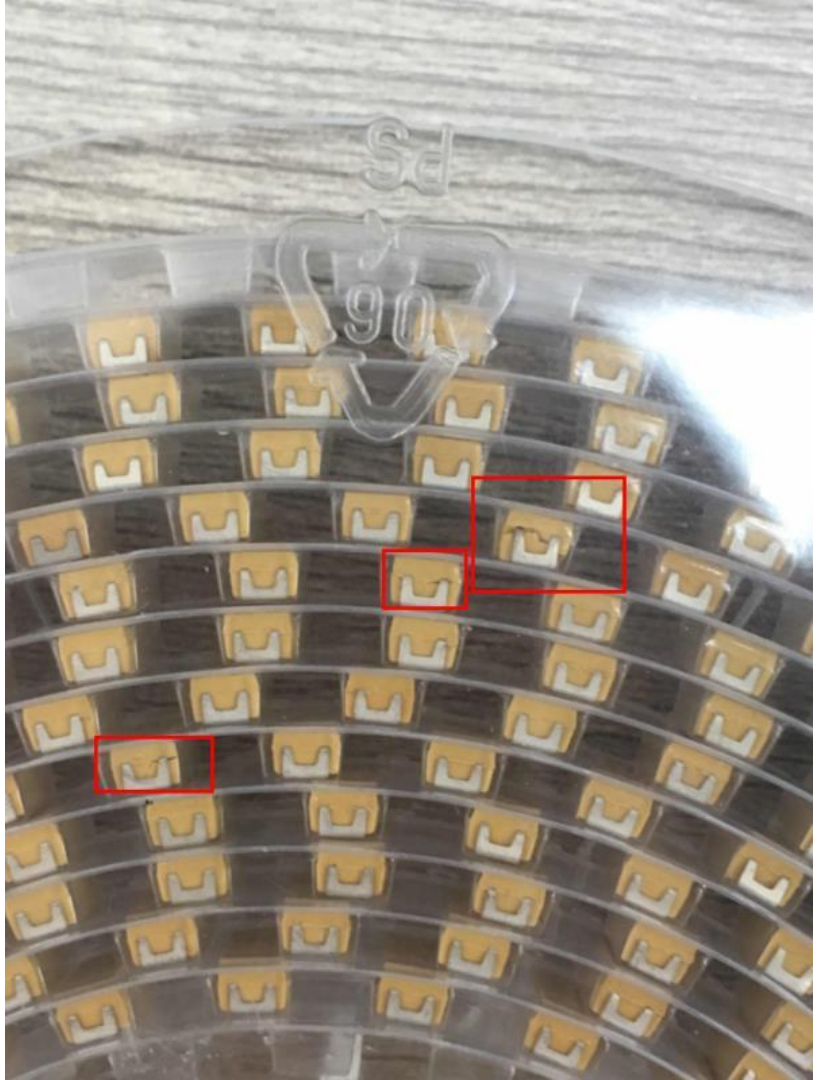

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Hardware Production - Lessons Learned

- Don’t always find the cheapest price as this will bring down the quality of goods. You might receive reels with some components broken or the manufactured product will face problems. The cheapest parts are either refurbished, scattered or clones.
- Non crucial components as resistors and capacitors should be replaced with cheaper no-name brands.
- Be ready to anticipate extra charges while production.
- Let them know how to test the finished product so you don’t have to do the testing yourself.
- Always know when are the public holidays.

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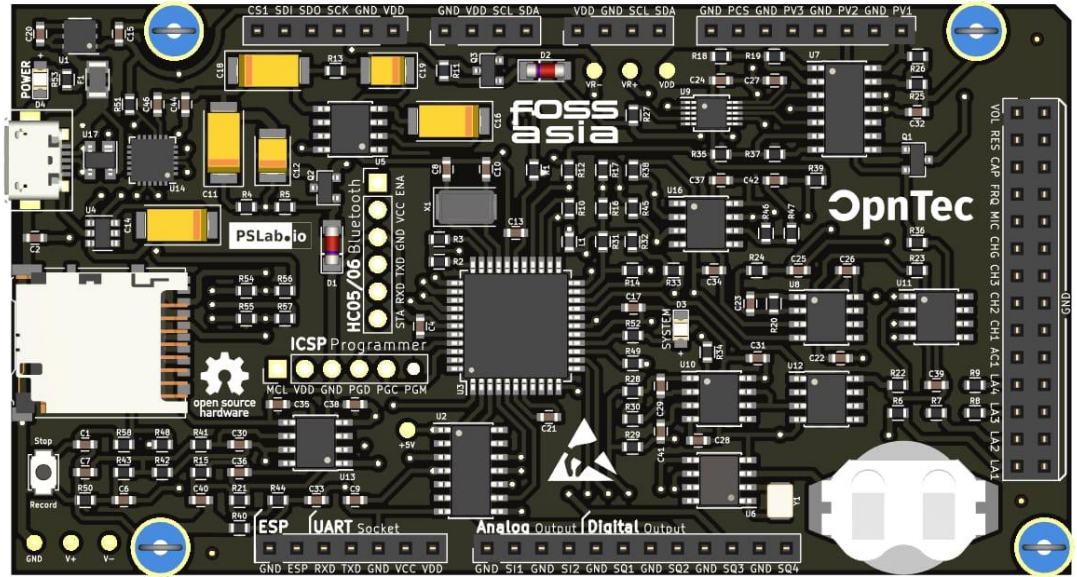
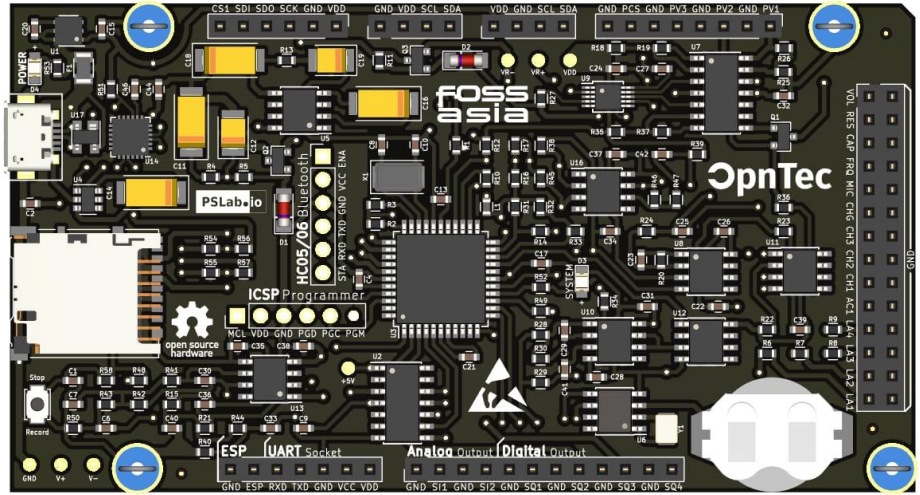
Pocket Science Lab Next

- ❑ Add SD Card
- ❑ Add small battery for time
- ❑ Additional pins
- ❑ Miniaturizing components where possible



Pocket Science Lab Next - Optional Components / Being Discussed



- ❑ GPS chip
- ❑ Sim card module
- ❑ Moving ESP to top
- ❑ Integrate sensors, e.g. Gyroscope, Accelerometer
- ❑ Mounts for screen
- ❑ Integration with LED Badge

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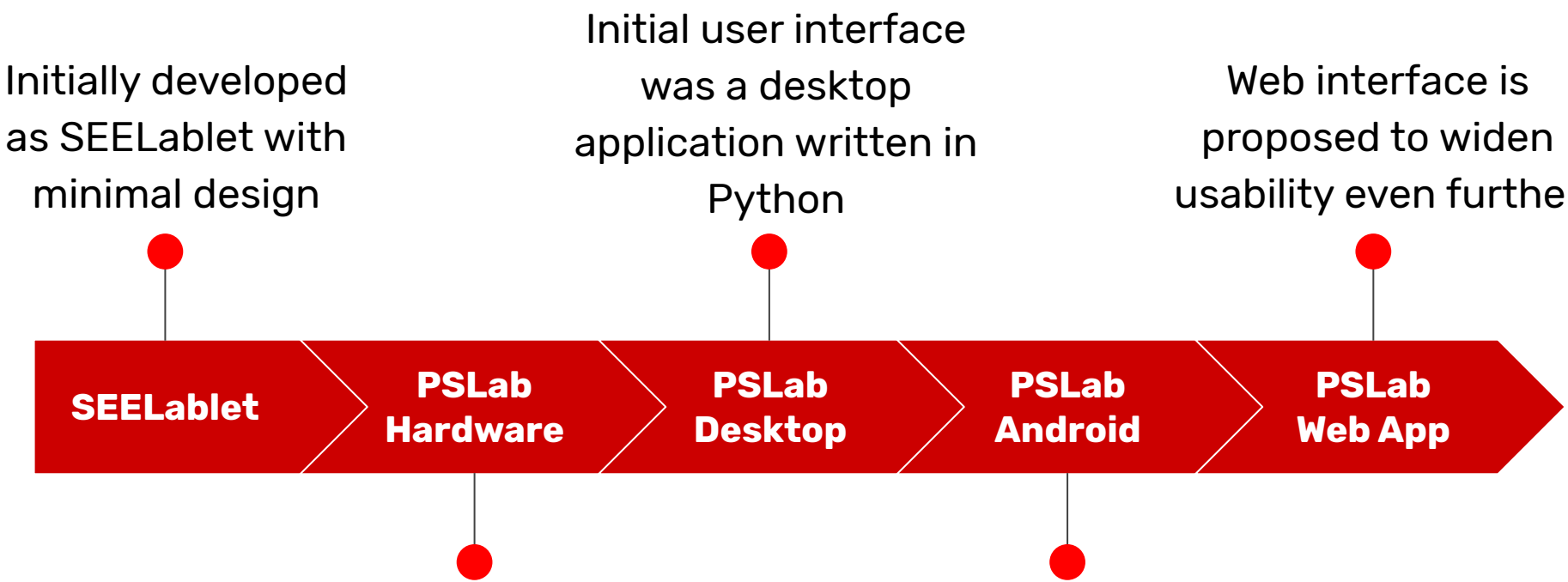
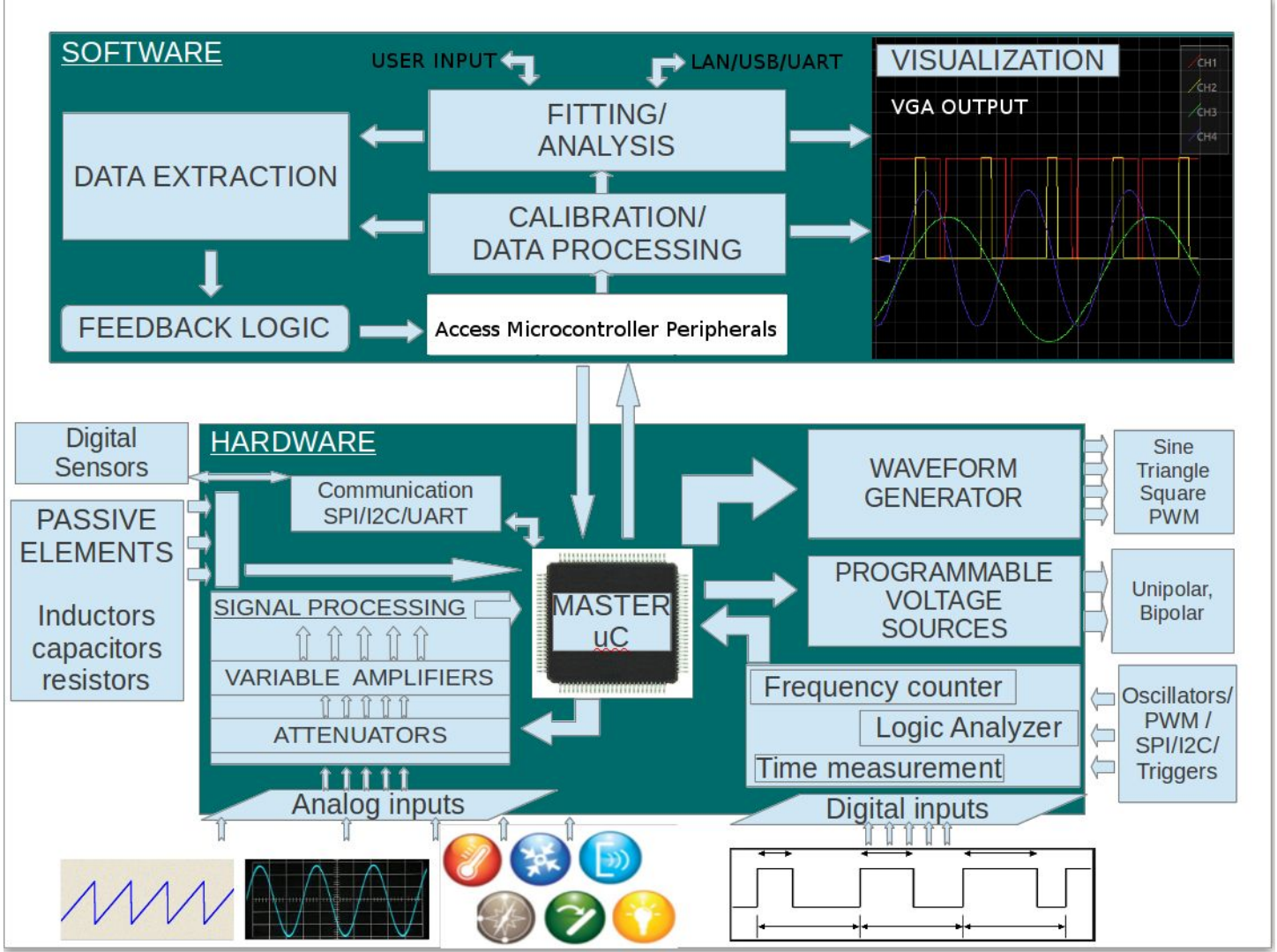
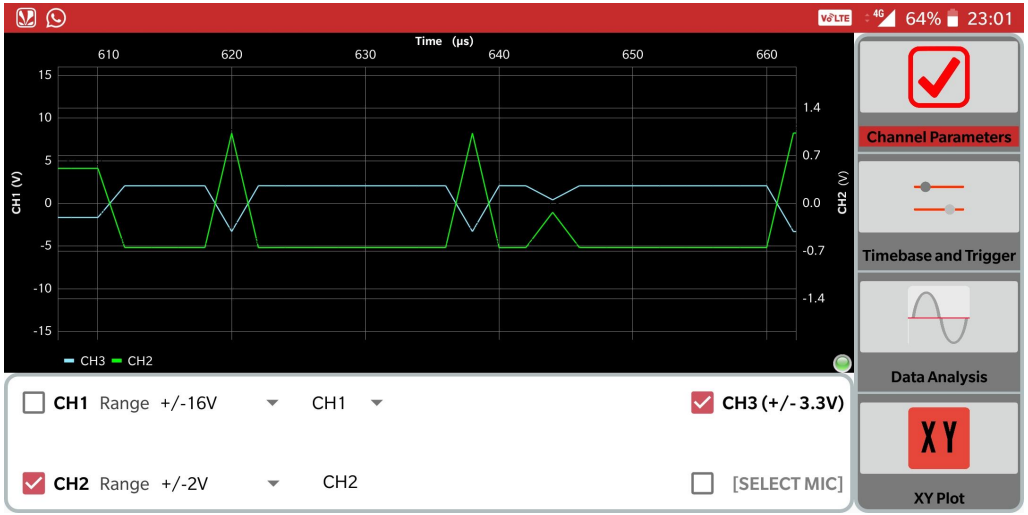
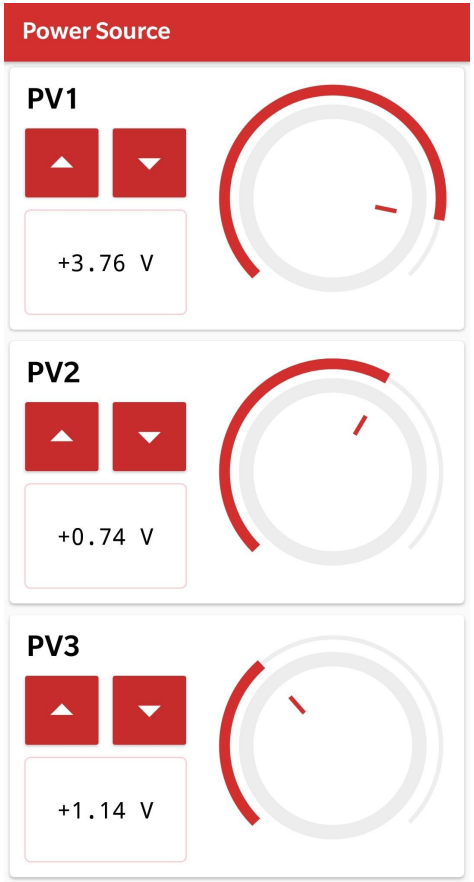

Initially developed as SEELablet with minimal design
Initial user interface was a desktop application written in Python
Web interface is proposed to widen usability even further
SEELablet
PSLab Hardware
PSLab Desktop
PSLab Android
PSLab Web App
Improved design and came out open source hardware design
Android application was developed to widen the usability


SOFTWARE
USER INPUT
LAN/USB/UART
VISUALIZATION
VGA OUTPUT
CH1
CH2
CH3
CH4
FITTING/
ANALYSIS
DATA EXTRACTION
CALIBRATION/
DATA PROCESSING
FEEDBACK LOGIC
Access Microcontroller Peripherals
Digital
Sensors
HARDWARE
Communication
SPI/I2C/UART
PASSIVE
ELEMENTS
Inductors
capacitors
resistors
SIGNAL PROCESSING
VARIABLE AMPLIFIERS
ATTENUATORS
MASTER
uC
WAVEFORM
GENERATOR
Sine
Triangle
Square
PWM
PROGRAMMABLE
VOLTAGE
SOURCES
Unipolar,
Bipolar
Frequency counter
Logic Analyzer
Time measurement
Oscillators/
PWM /
SPI/I2C/
Triggers
Analog inputs
Digital inputs

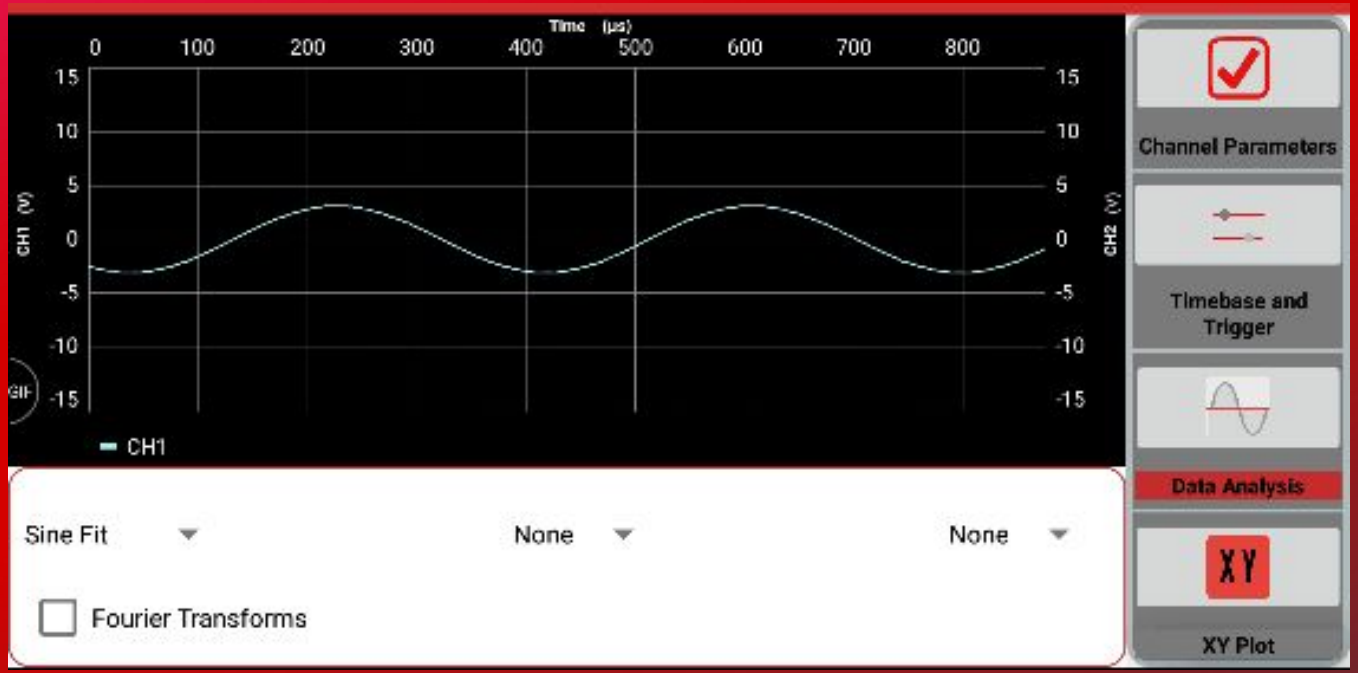


Oscilloscope



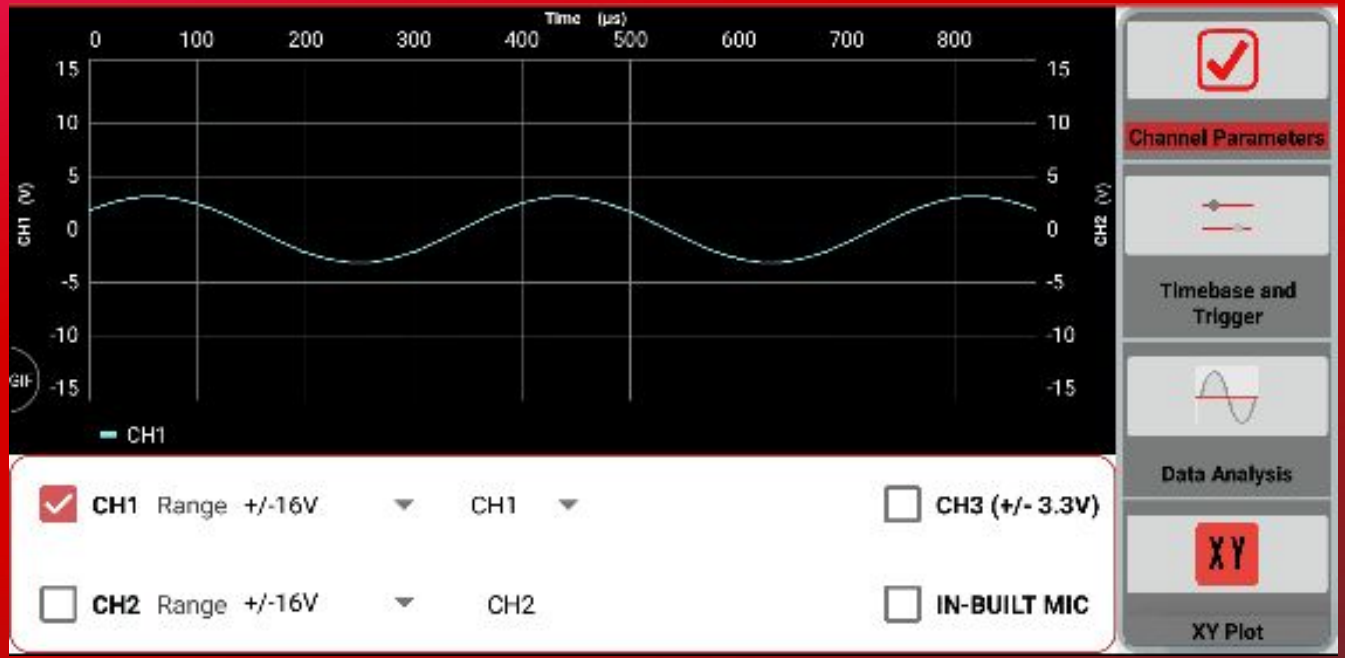
Power Source

PSLab Android - Oscilloscope

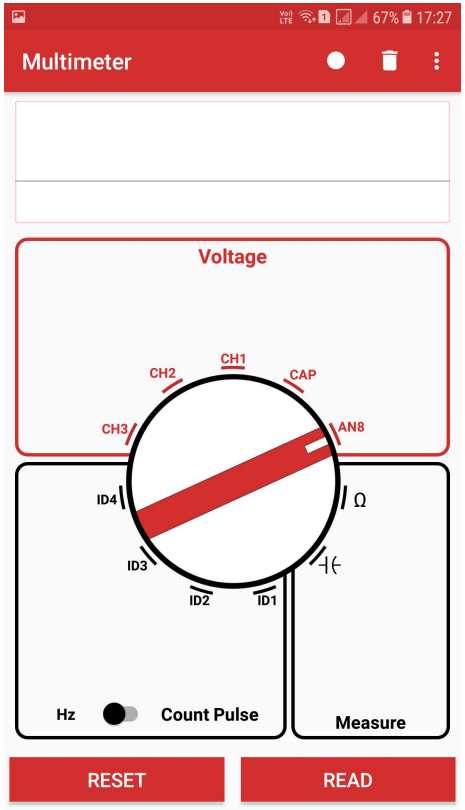


Sine and square fitting for waves added

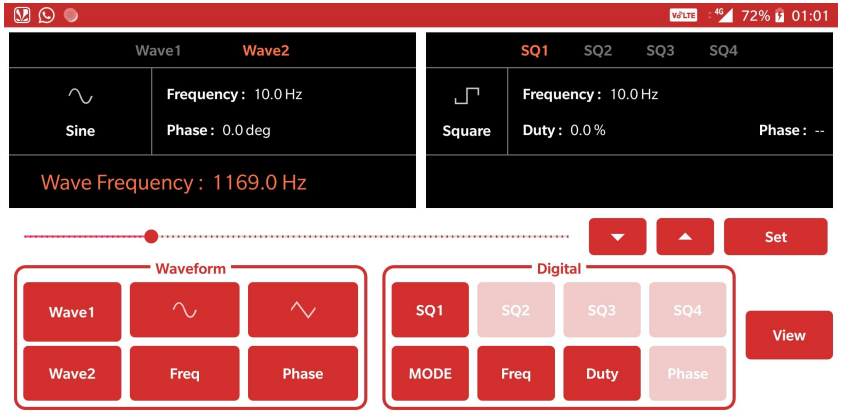
PSLab Android - Oscilloscope Built-in Mic



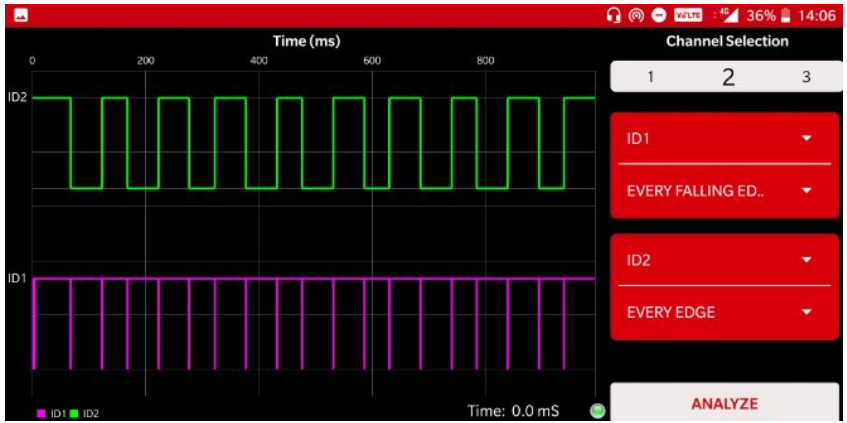
User can use smart phone microphone as input



Multimeter

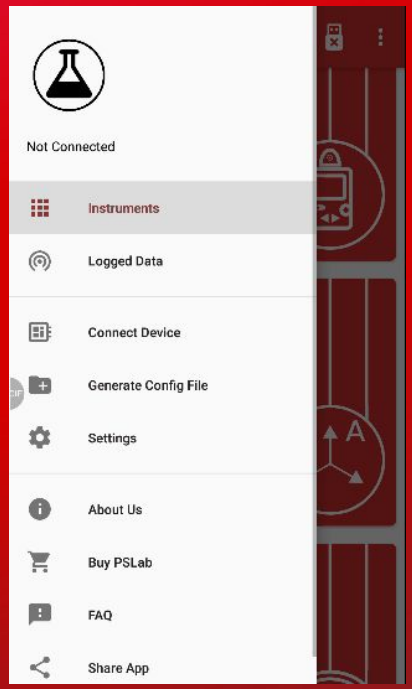


Wave Generator



Logic Analyzer

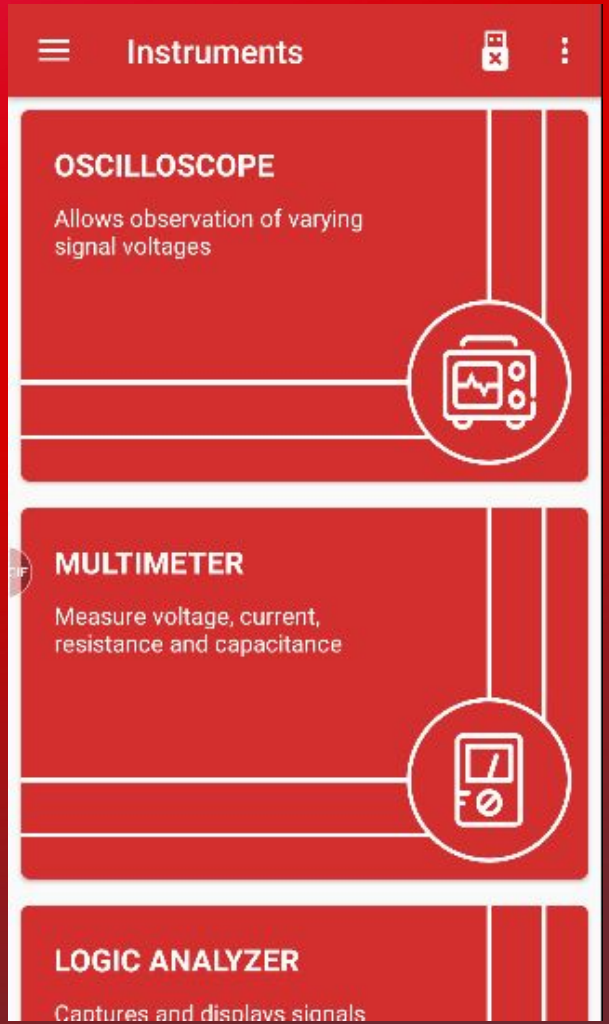
PSLab Android with Maps



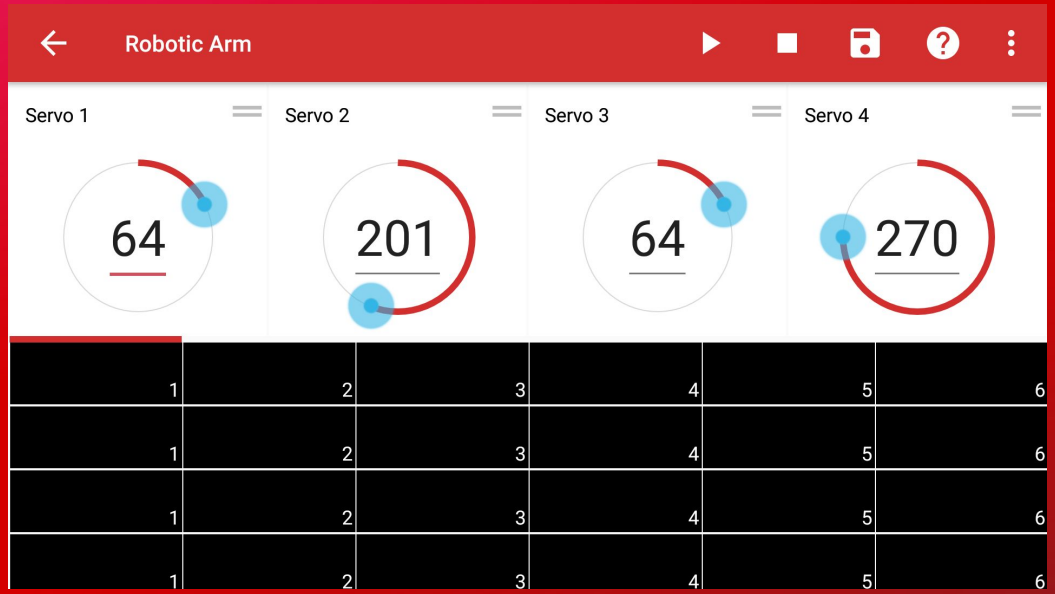
2 different flavors: Play Store and Fdroid supporting OpenStreetMap and GMaps

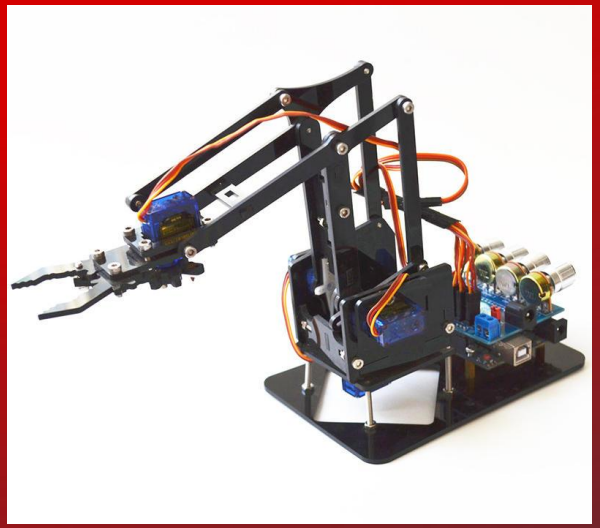
PSLab Android - Generate Config

Generate config files for instruments and transfer it to PSLab board to log the data automatically.



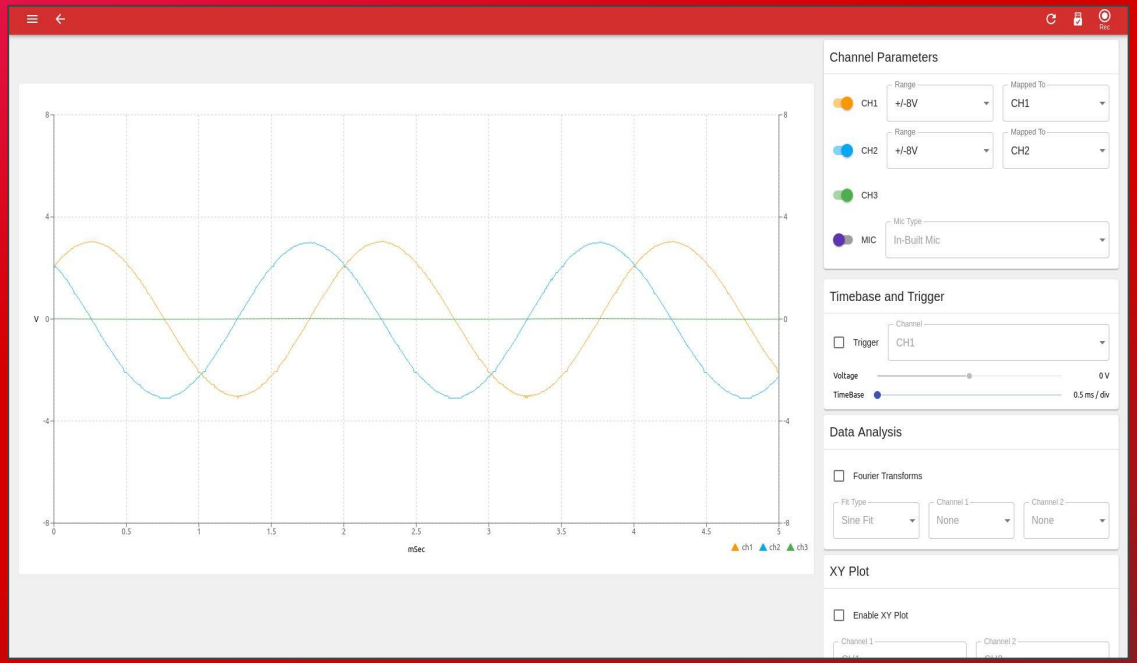
PSLab Android - Robotic Arm

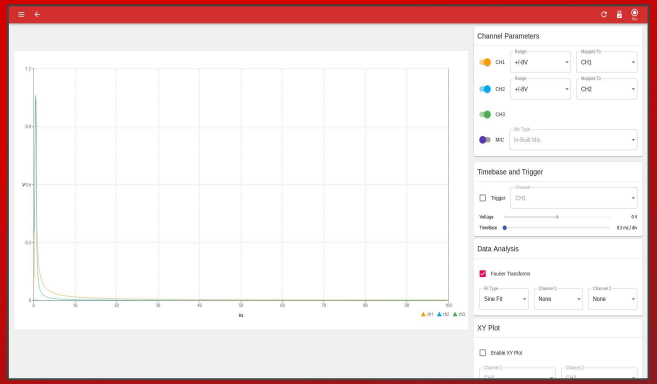


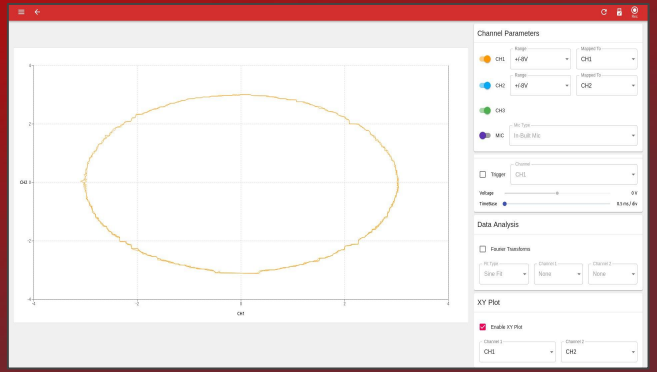


User can use this feature to control 4 servos of the robotic arm.

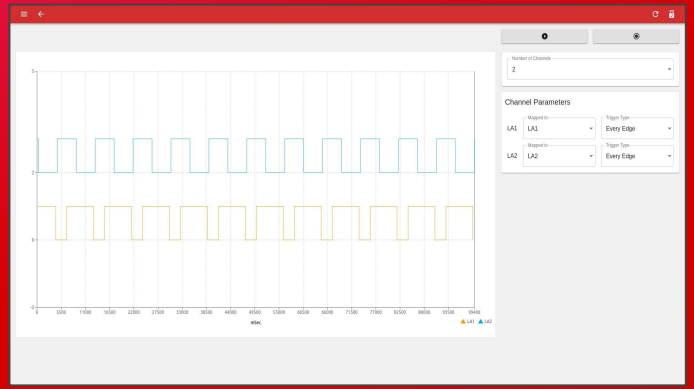
PSLab Desktop - Oscilloscope



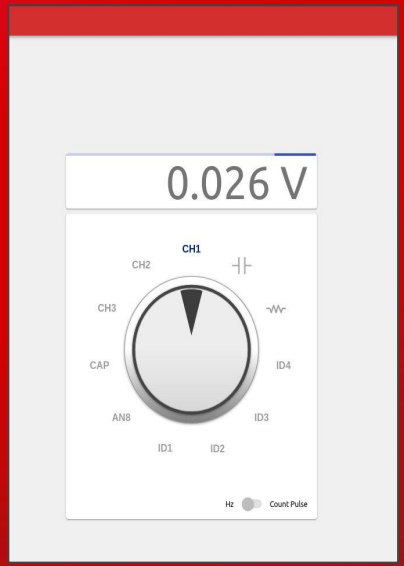




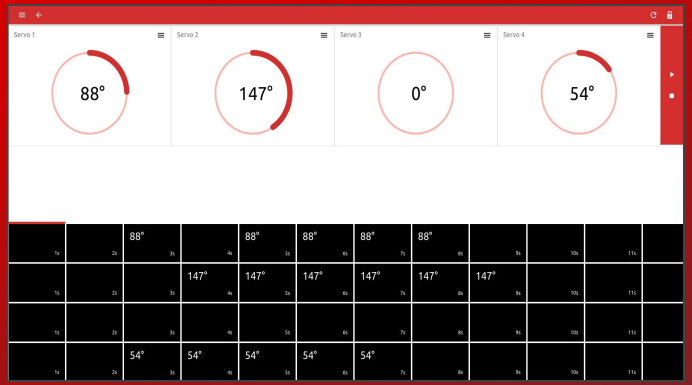
PSLab Desktop



Logic Analyzer



Multimeter

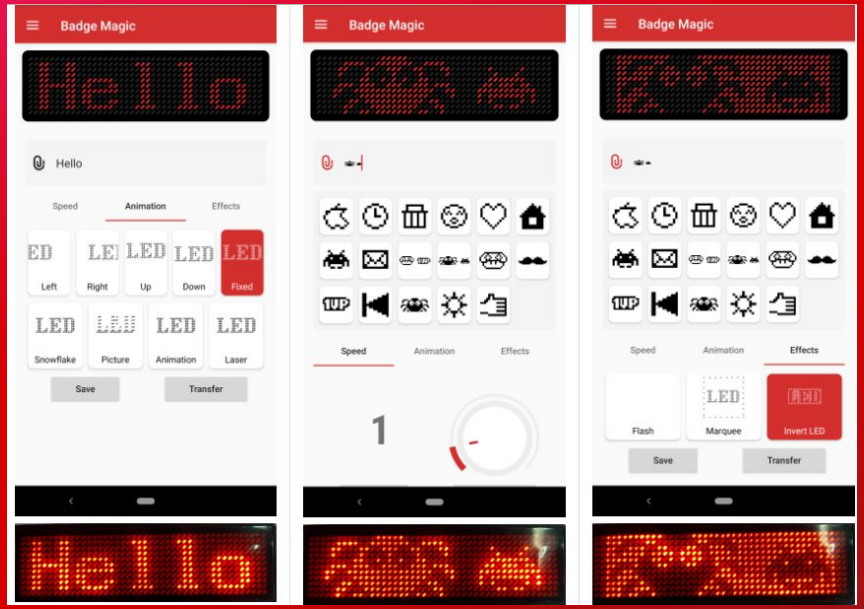


Robotic Arm

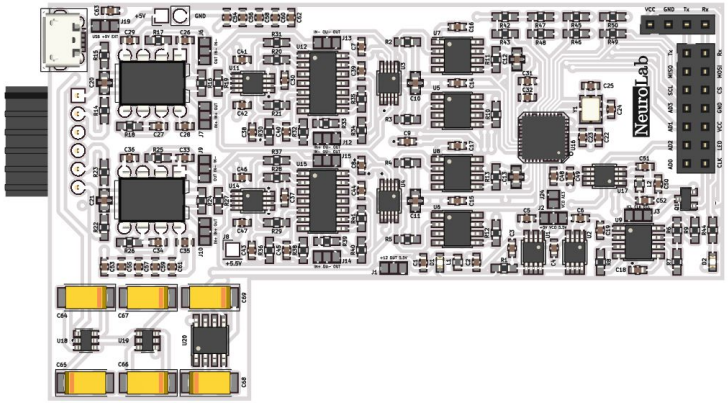
How to make Open Hardware Economically Sustainable

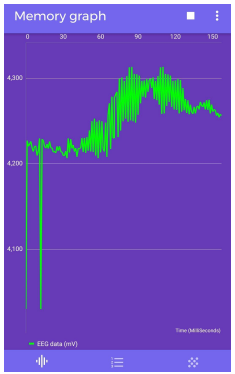
- Create a business around it: Sell it, fund developers and production.
- Build a community. Projects can be forked and copied, communities can not
- Create an ecosystem of Open Hardware + Free/Open Source Software with regular updates (Constant new releases make it hard for copycats to keep up)
- Create developer documentation
- To do: Create good end-consumer documentation

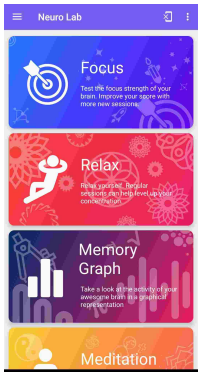
LED Badge Magic

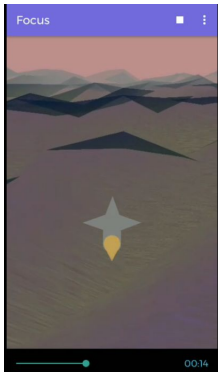


Neurolab









Where to get our hardware

- PSLab github.com/fossasia/pslab-hardware
- FOSSASIA Stand
- FOSSASIA.com
- Europe/Singapore: PSLab.io
- China: Seed Studio, Tao Bao
- Japan: switch-science.com

FOSSASIA Summit Singapore
Lifelong Learning Institute, March 19 - 21, 2020
summit.fossasia.org

OpenTechSummit Berlin
TU Berlin, May 20 - 21, 2020
opentechsummit.eu

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