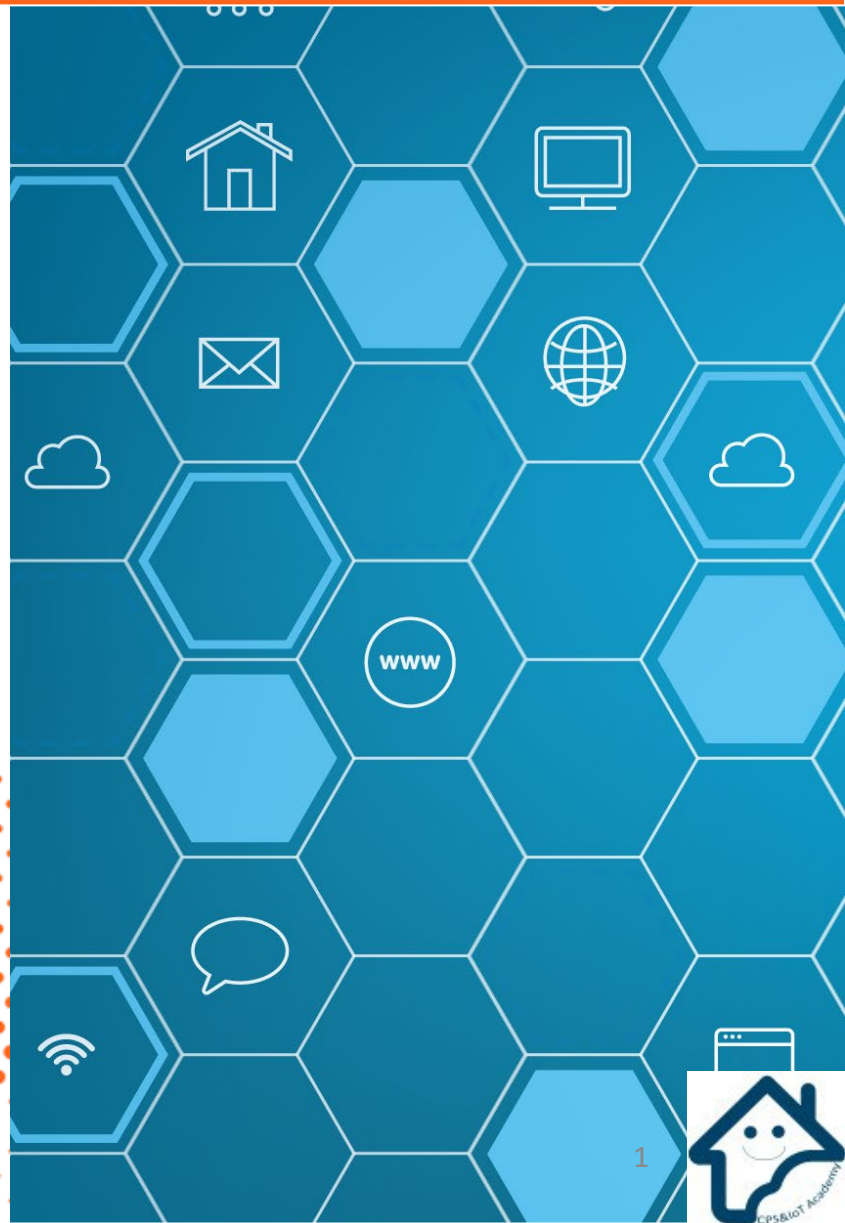
Komunikacija za biomedicinske uređaje

Đurković Jovan, *MANT & MECOnet*

jovan@meconet.me

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Wire i wireless

Aspekt komunikacije: wearable <-> local host (desktop ili gadget)

Žičana komunikacija

- USB
- Audio (pomoću kabla)

Bežična komunikacija

- RF
- BT / BLE
- WiFi
- Audio (pomoću mikrofona)

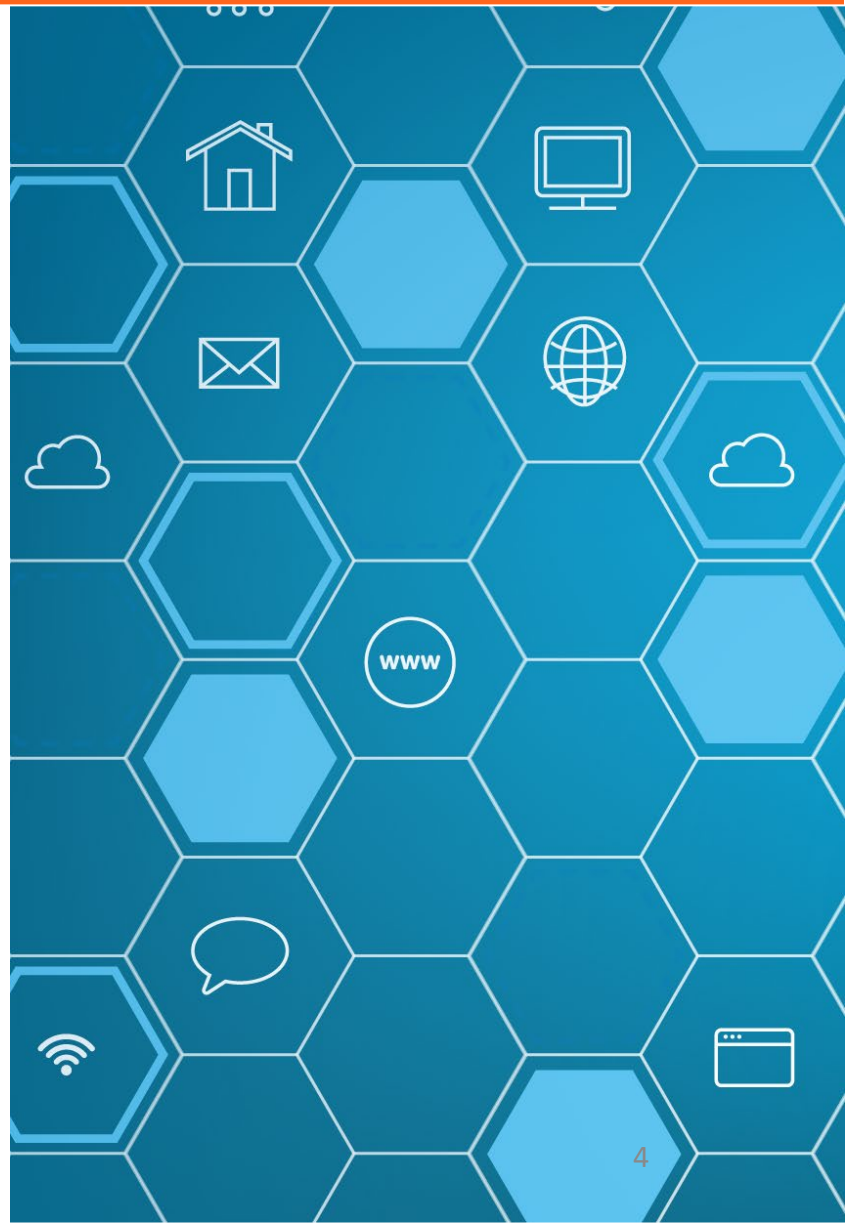
Wire

USB

- Primanje podataka sa medicinskog uređaja na računar ili telefon
- Brza komunikacija, naročito sa računarom
- Zahtijeva USB interfejs
- Potrebno je uskladiti podešavanja kod oba uređaja (brzinu komunikacije, veličinu znakova, parnost, broj stop bita)
- PC: SerialOscilloscope, SerialPlot, Arduino Serial Monitor, Matlab...
- Telefon: Serial USB Terminal, RobRemo, MIT App Inventor...

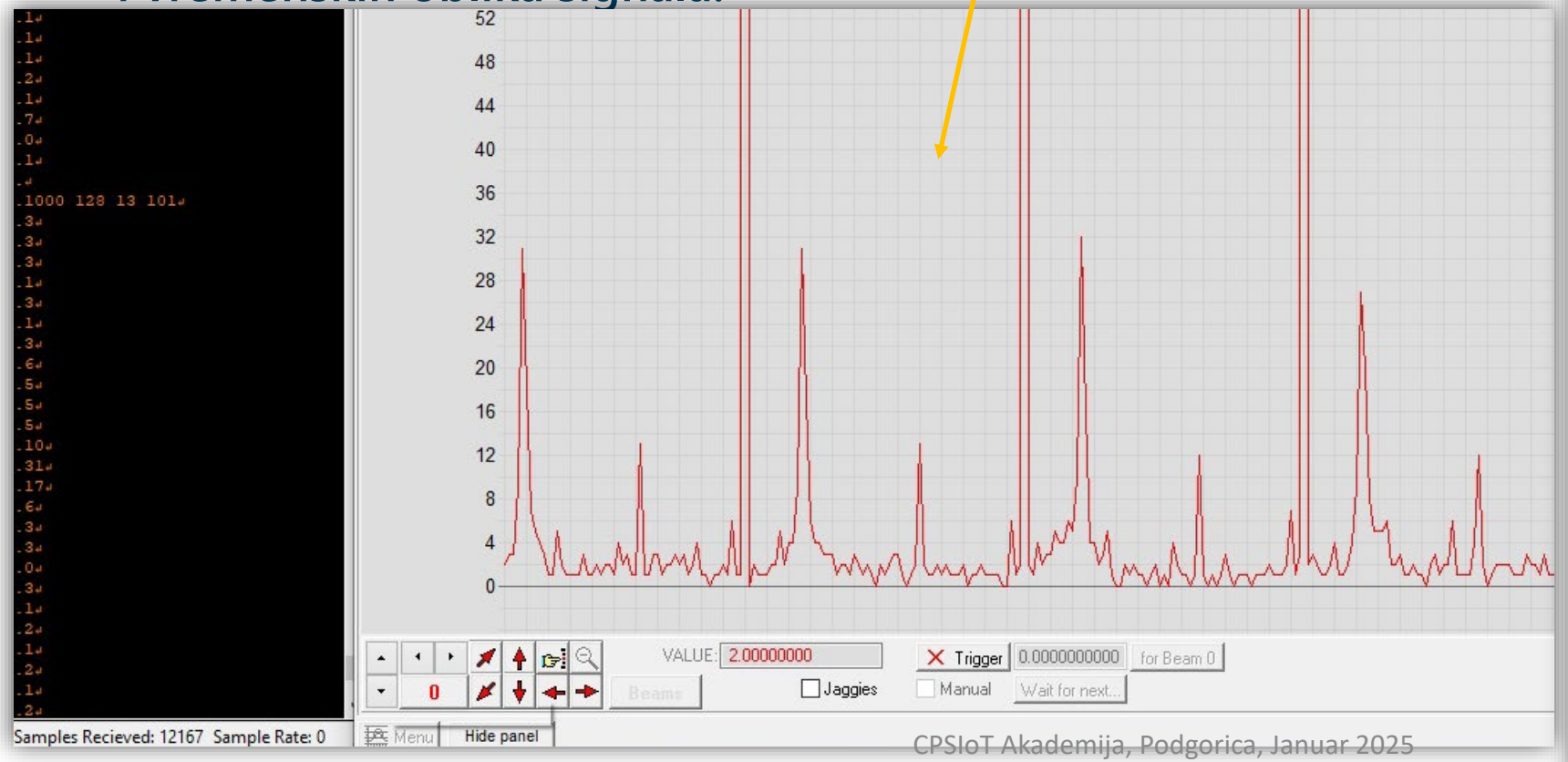
Audio

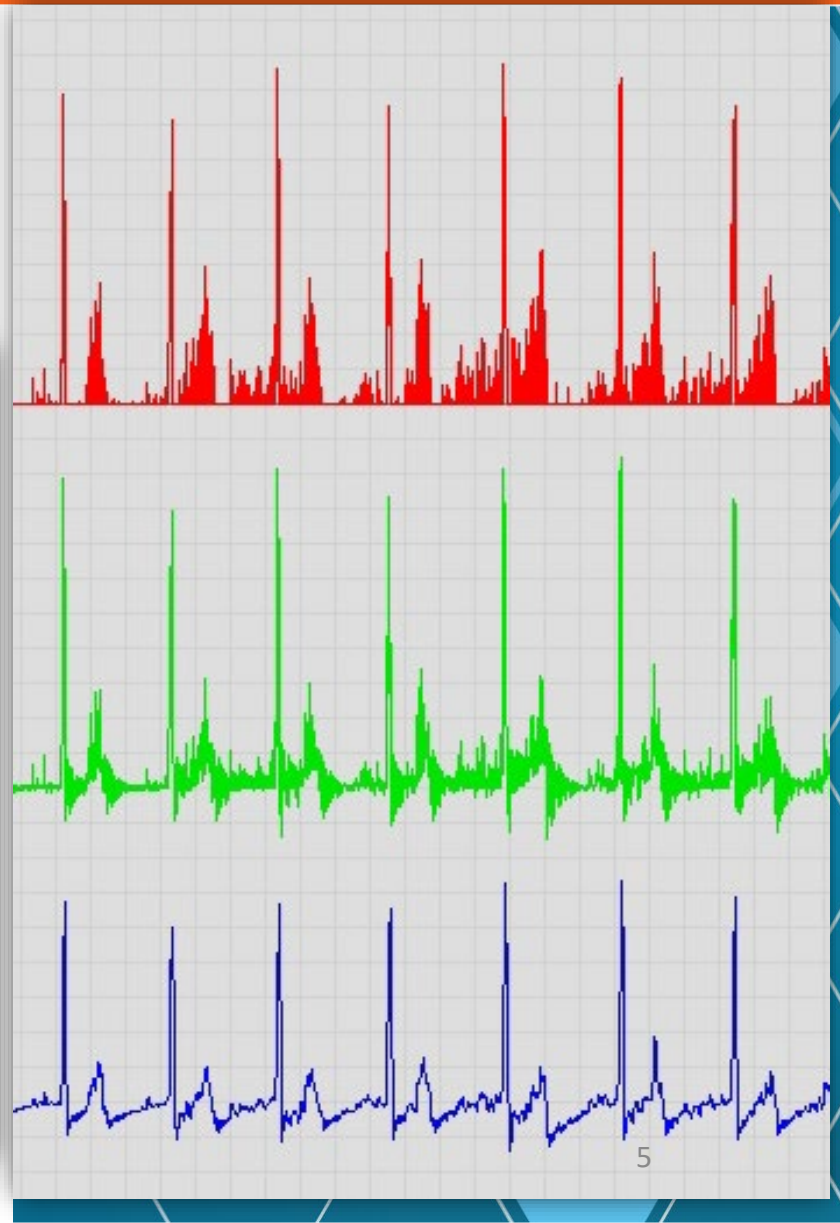
- Bilo koji računar ili telefon sa audio priključkom i snimač zvuka



Wire-serial over USB

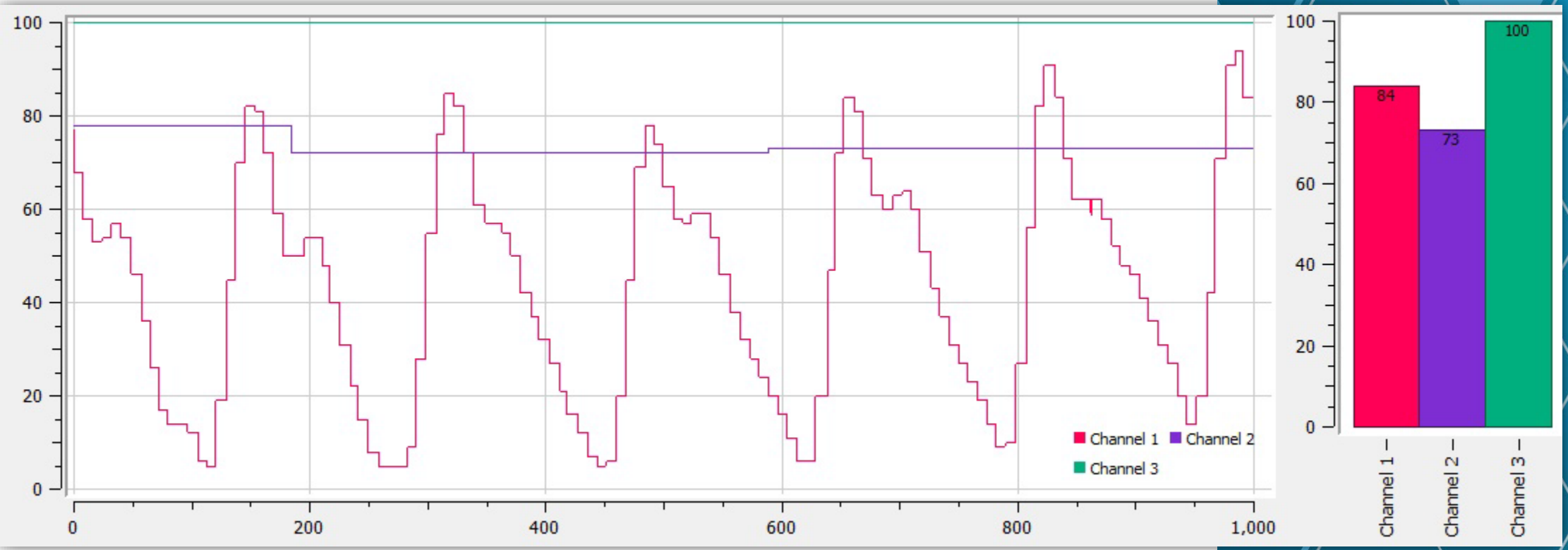
- Serial Oscilloscope, Primjer crtanja FFT spektra signala (Frekventni domen) kao i vremenskih oblika signala.





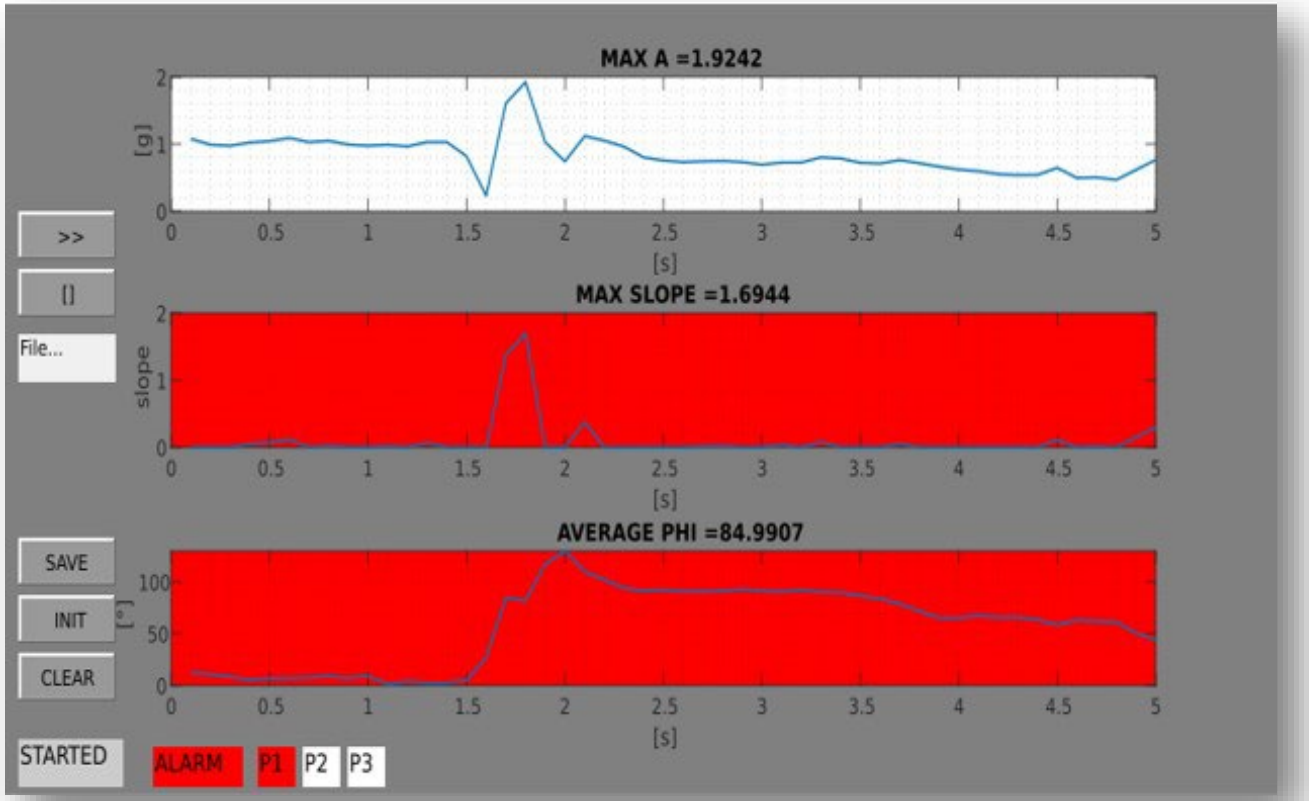
Wire-serial over USB

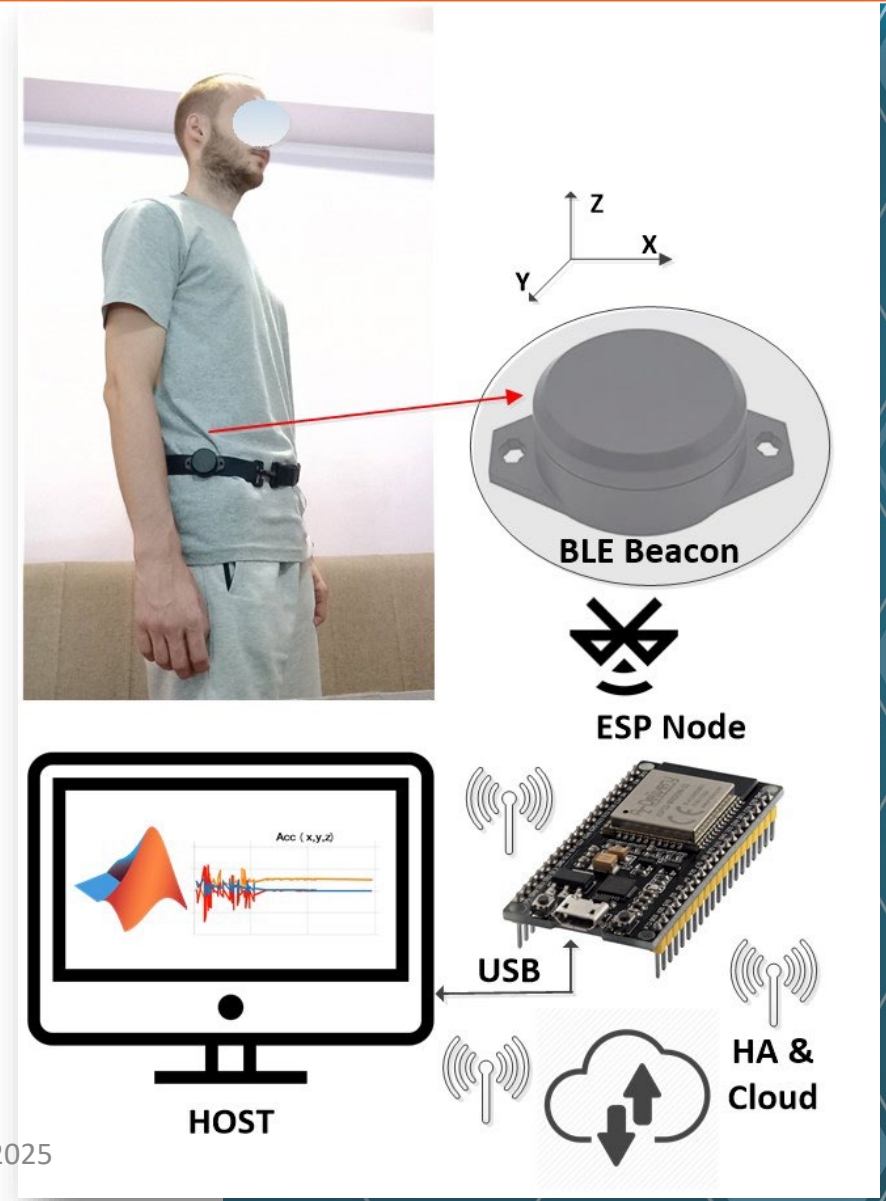
- SerialPlot, primjer korišćenja plotera za crtanje signala.



Wire-serial over USB

- MATLAB, primjer detektora pada

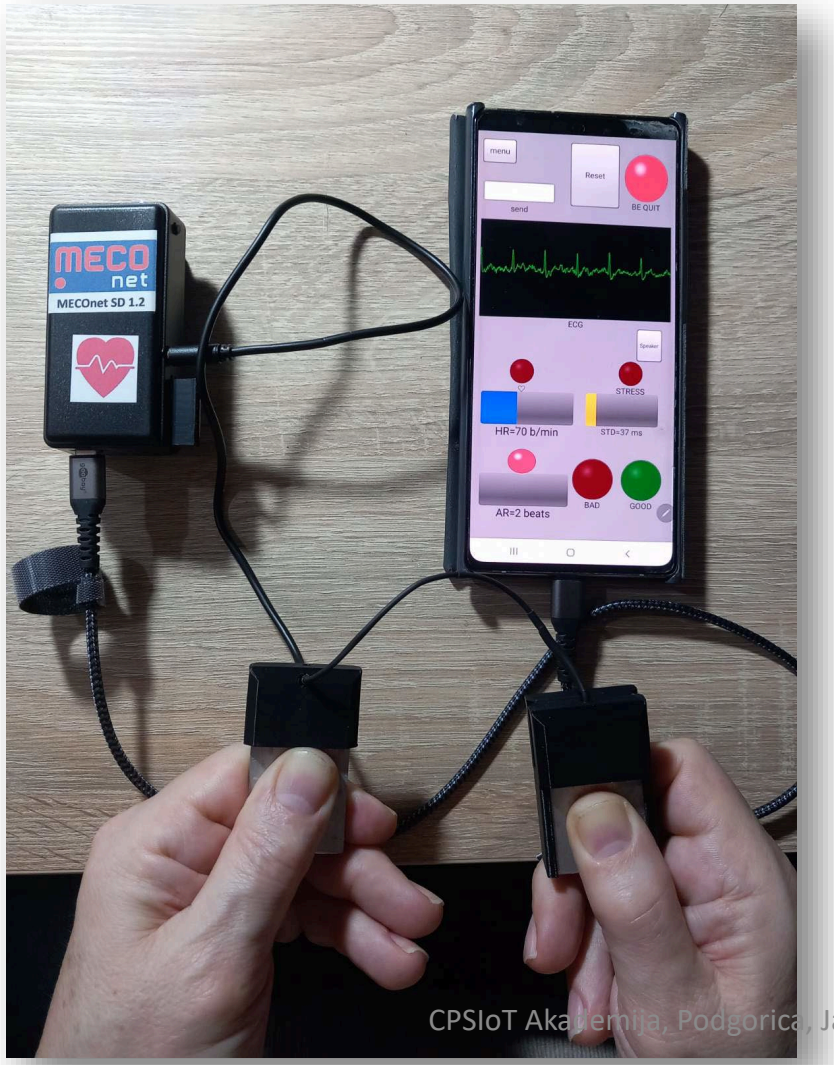




Wire-serial over USB

- Stress detector.

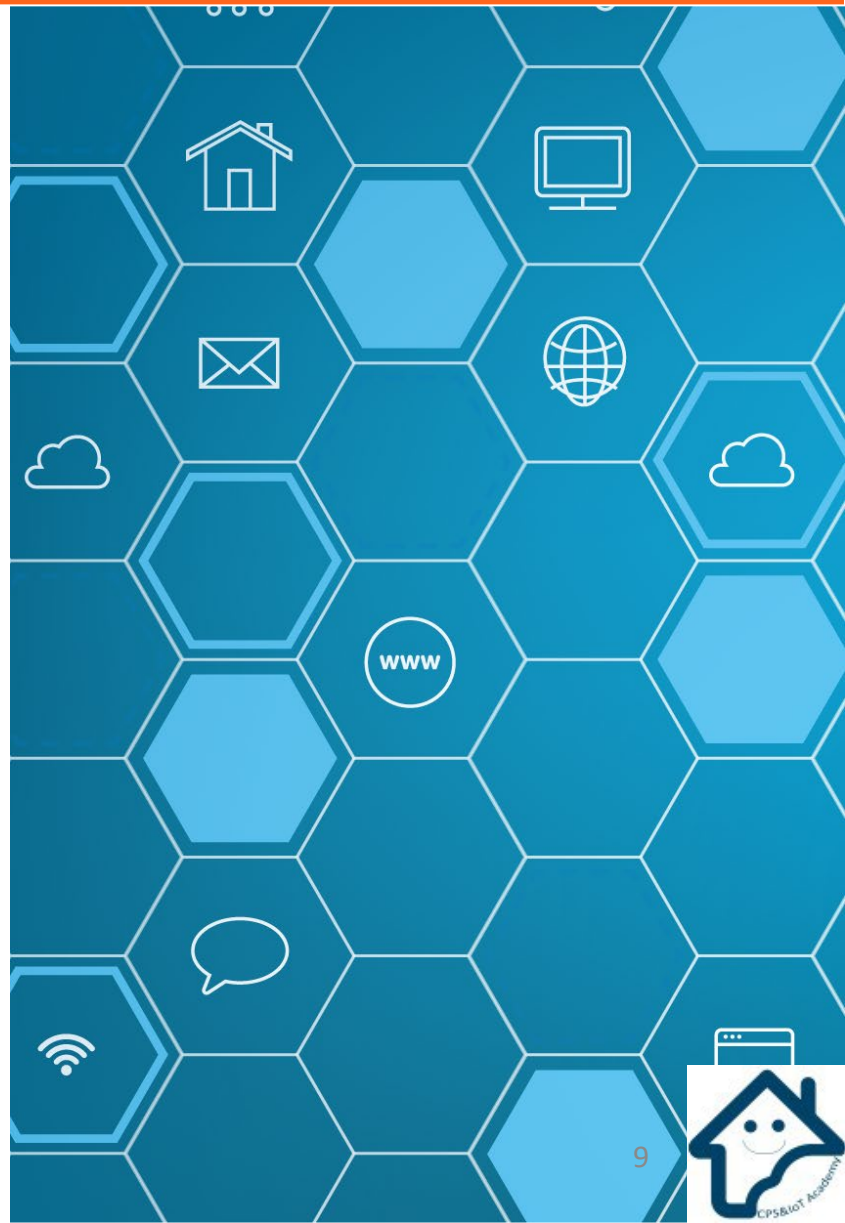
  Primjer aplikacije za vizualizaciju podataka primljenih preko USB.



In audio

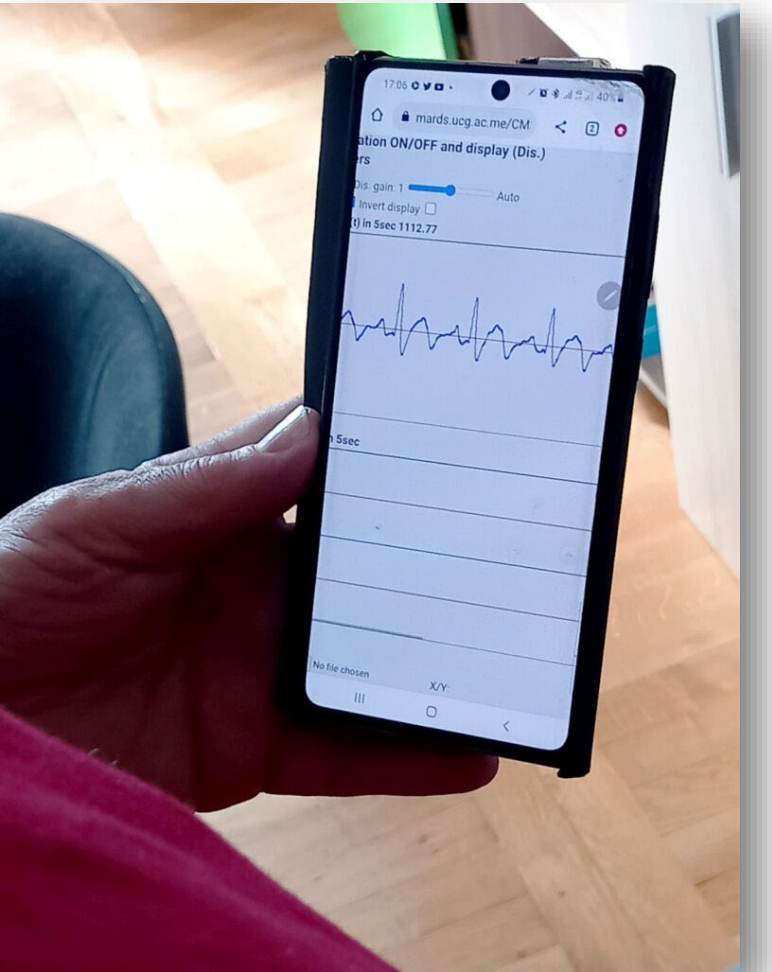
Audio - modulacija / demodulacija

- Razmjena podataka između dva ili više uređaja
- Jednosmjerna komunikacija
  - Domet zavisi od amplitude zvuka
  - Analogni signal
- Frekvencijski opseg je ograničen karakteristikama mikrofona
  - 20Hz-20KHz za obične mikrofone
  - Do 96KHz i više za zvučne kartice, putem kabla
  - Frekvencija odabiranja mora da bude najmanje dva puta veća od najveće frekvencije signala



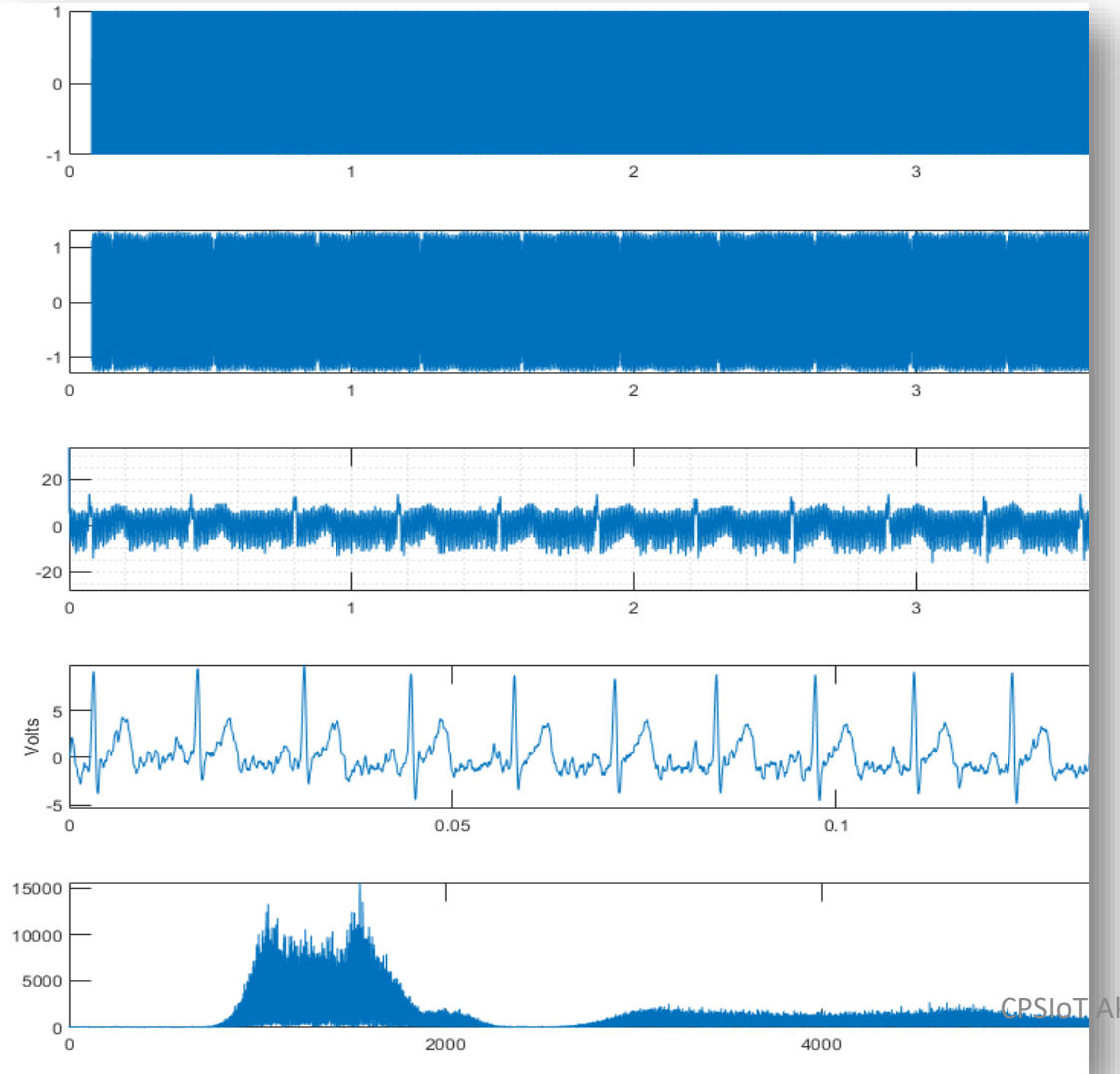
In audio

- Snimanje putem kabla:
- Snimanje putem mikrofona:

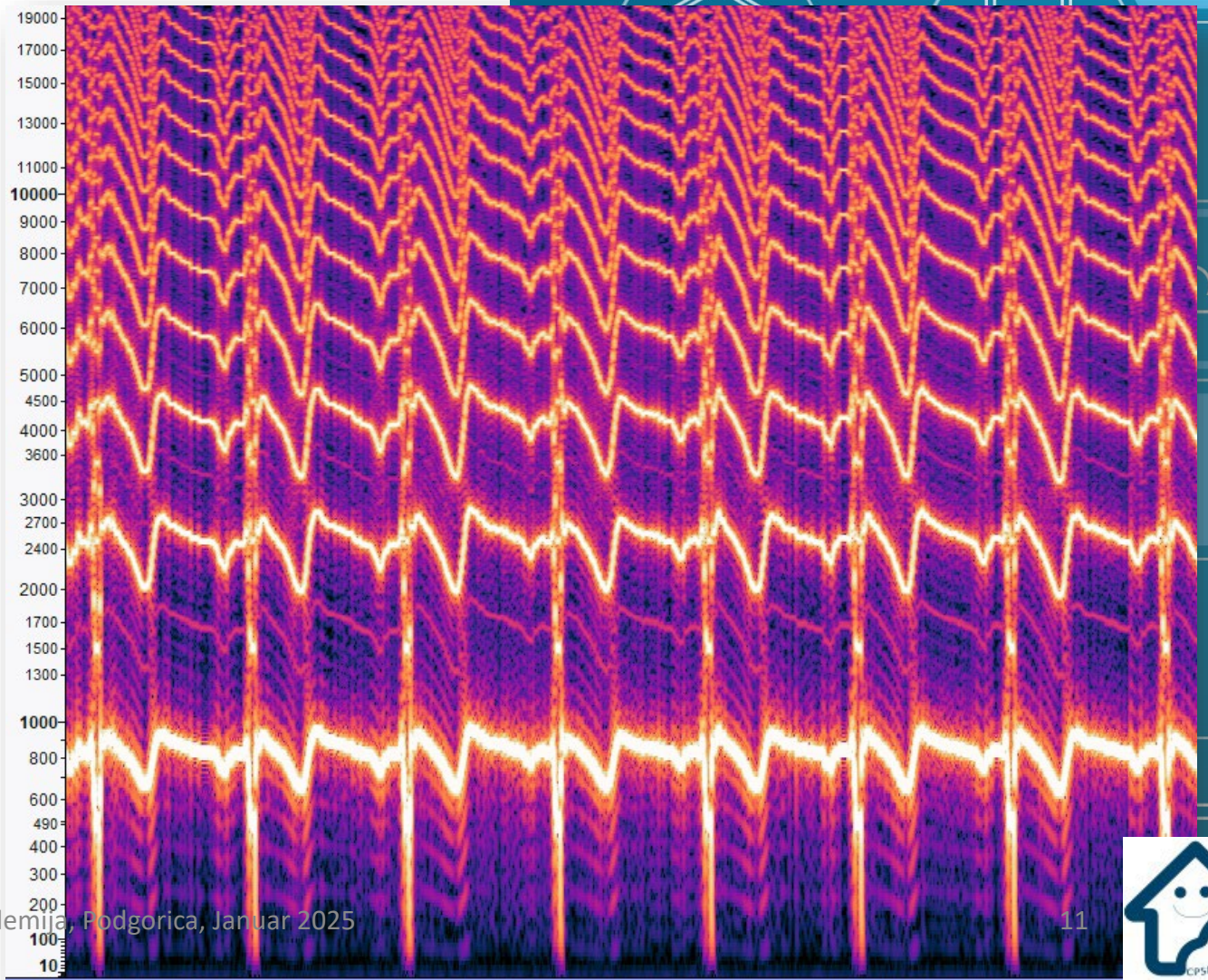


In audio

- Obrada u matlabu



- Audacity, spektrogram



RF

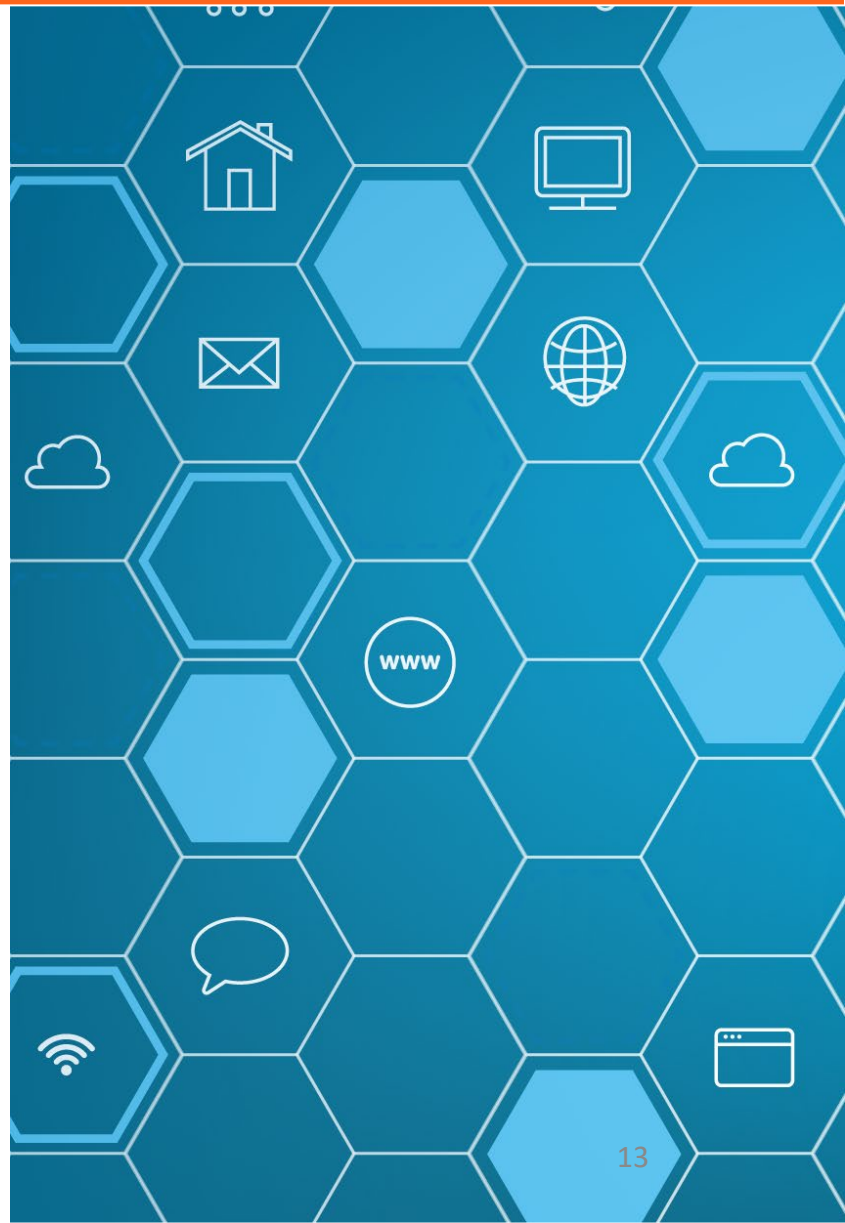
RF

- Razmjena podataka između više uređaja
- Jednosmjerna ili dvosmjerna komunikacija
- 433MHz, 868MHz, 2.4GHz...
- Domet i brzina zavise od RF modula koji se koristi
  - 10m-1000m
  - 1-10kbps, 250kbps-2Mbps
- Moduli: FS1000A + XY-MK-5V, SYN115 + SYN480R, NRF24L01...

BT

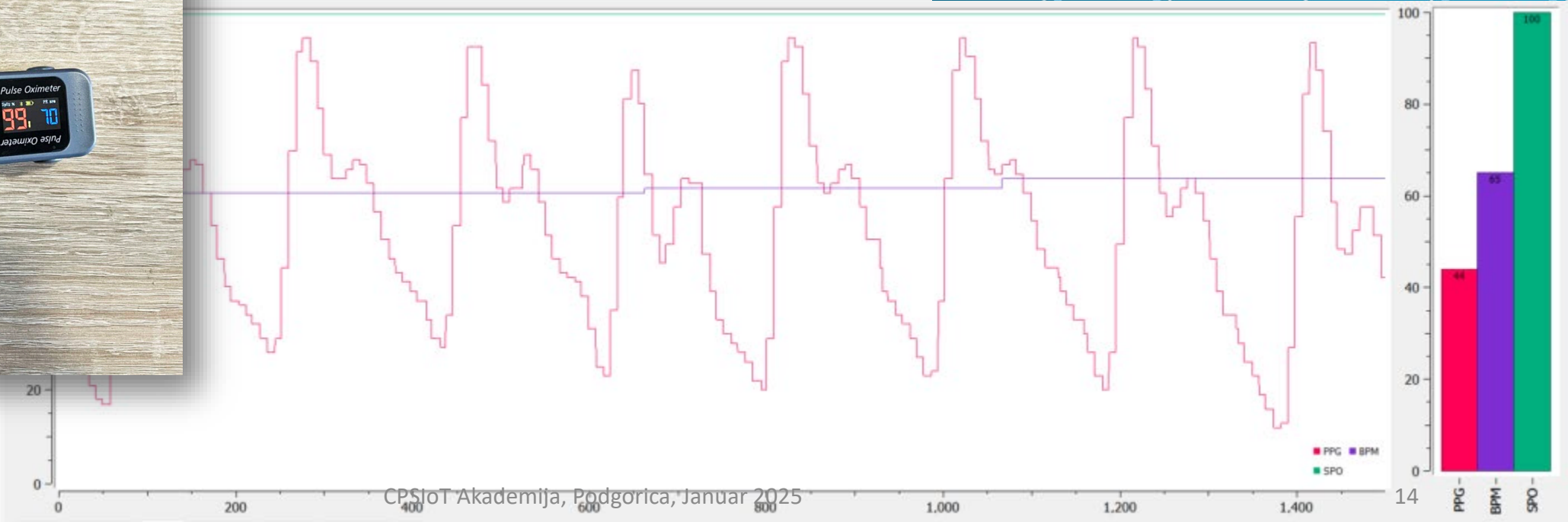
Bluetooth / BLE

- Razmjena podataka između dva uređaja
- Dvosmjerna komunikacija
  - BT: 10m, 1Mbps
  - BLE: 30m, 1-2Mbps
- Moduli BT 2.0: HC-05, HC-06, JDY-08...
- Moduli BLE: HM-10, HM-11, nRF8001
  - Arduino Nano 33 BLE
  - ESP32, ESP32-S2, ESP32-C3, ESP32-C6, ESP32-S3
- Android: Bluetooth LE Scanner, Serial Bluetooth Terminal, BLE Scanner, LightBlue, nRF Connect



BT

Bluetooth / BLE



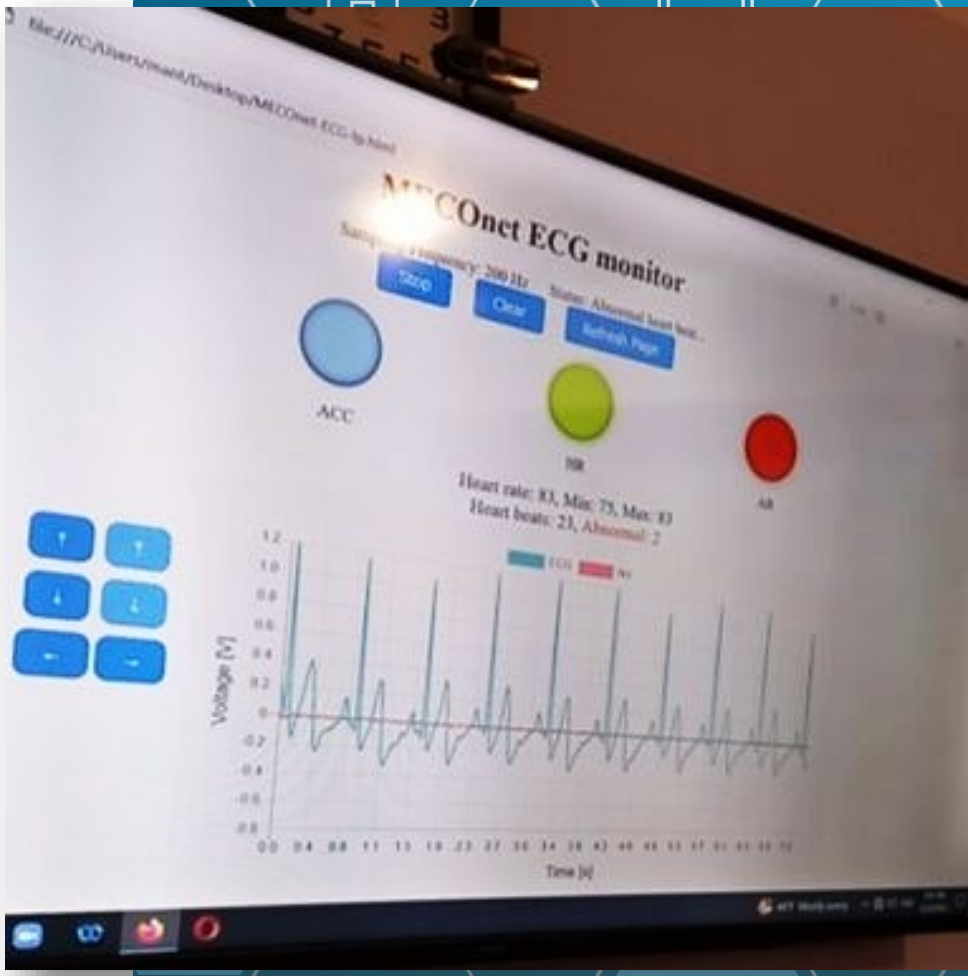
WiFi

WiFi

- Web socket metod
- Razmjena podataka između dva ili više uređaja
- Dvosmjerna komunikacija
  - 50-100m
  - 70-150Mbps
- Moduli: Wi-Fi Shield 101, ESP01, Wemos D1 Mini
- Arduino Nano 33 IoT
- ESP32, ESP32-S2, ESP32-C3, ESP32-S3
- Web browser
- Android: RoboRemo, MIT App Inventor...

WiFi

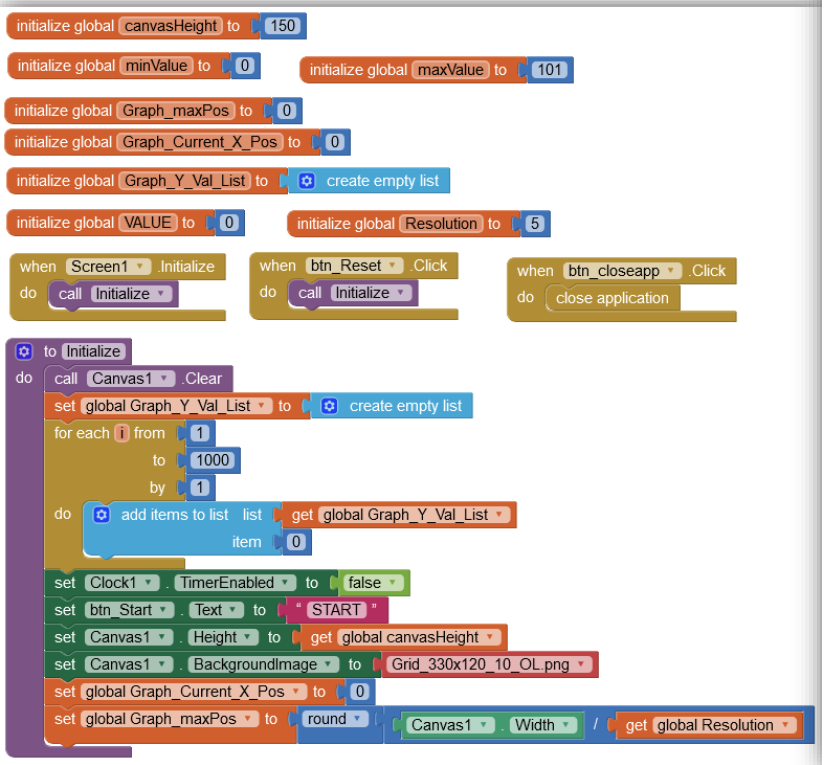
Web socket

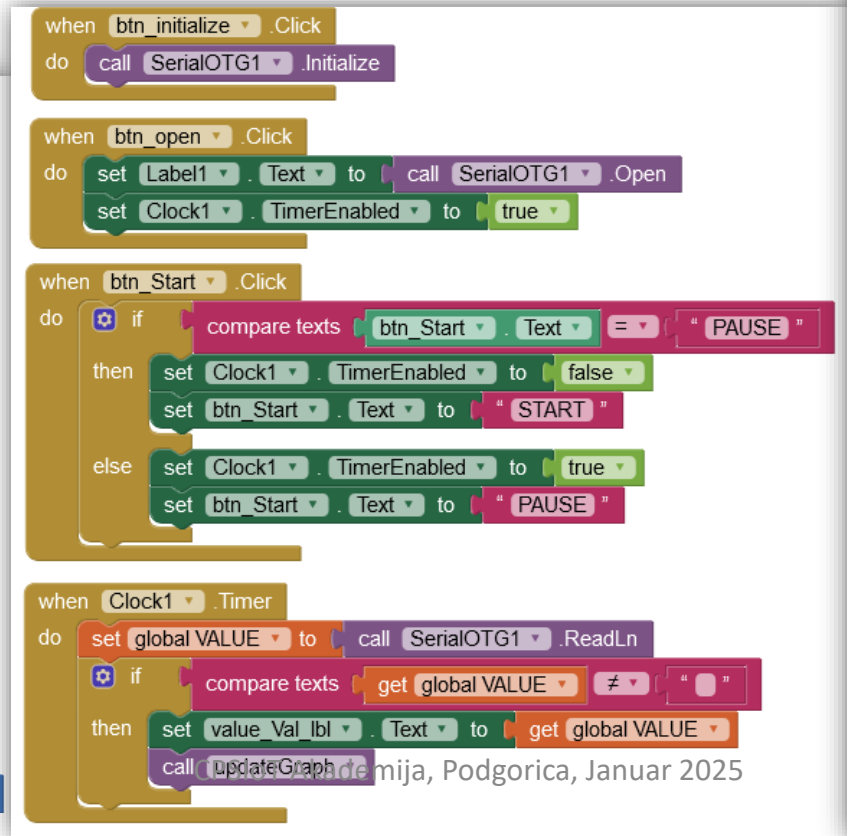


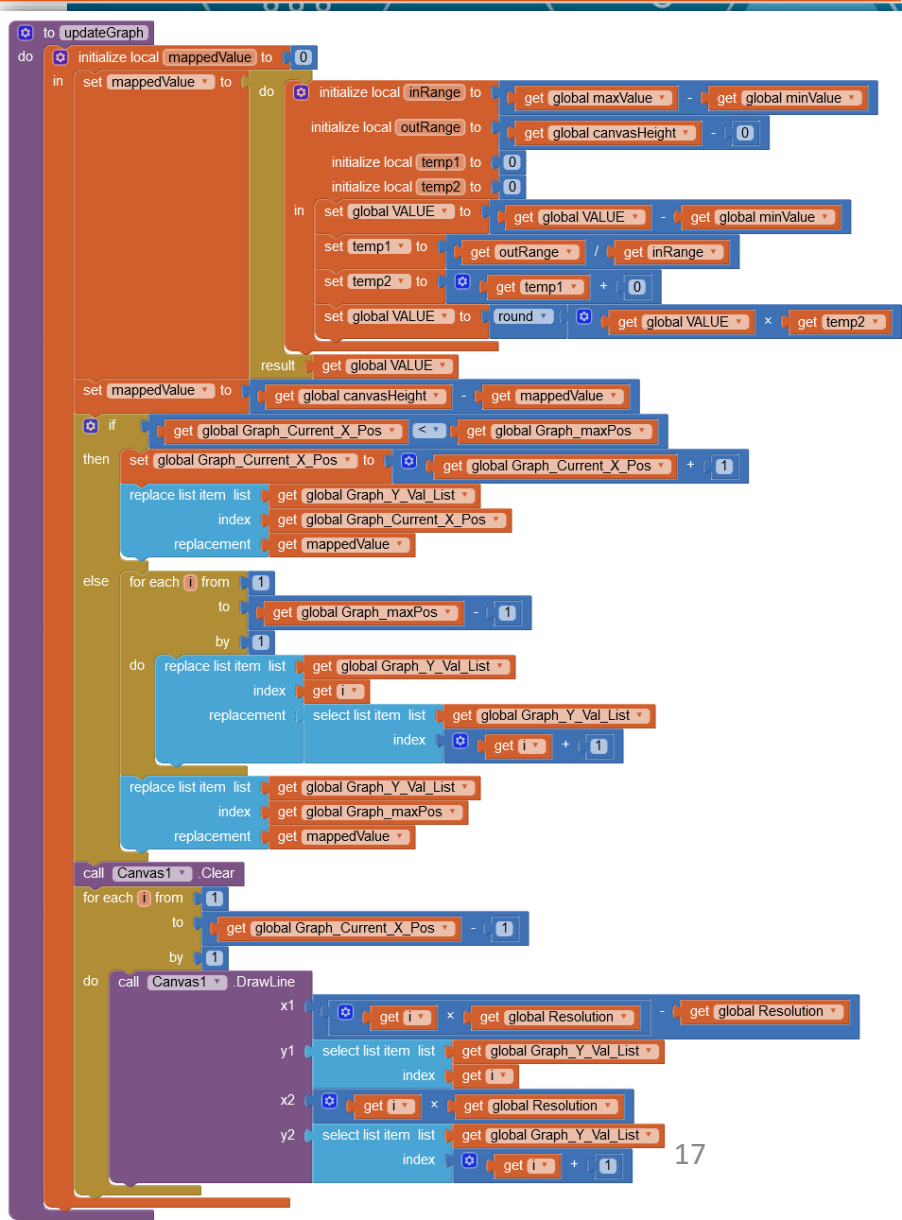
Vizualizacija

Mobilne aplikacije

- MIT App Inventor
  - Onlajn razvojno okruženje, besplatna





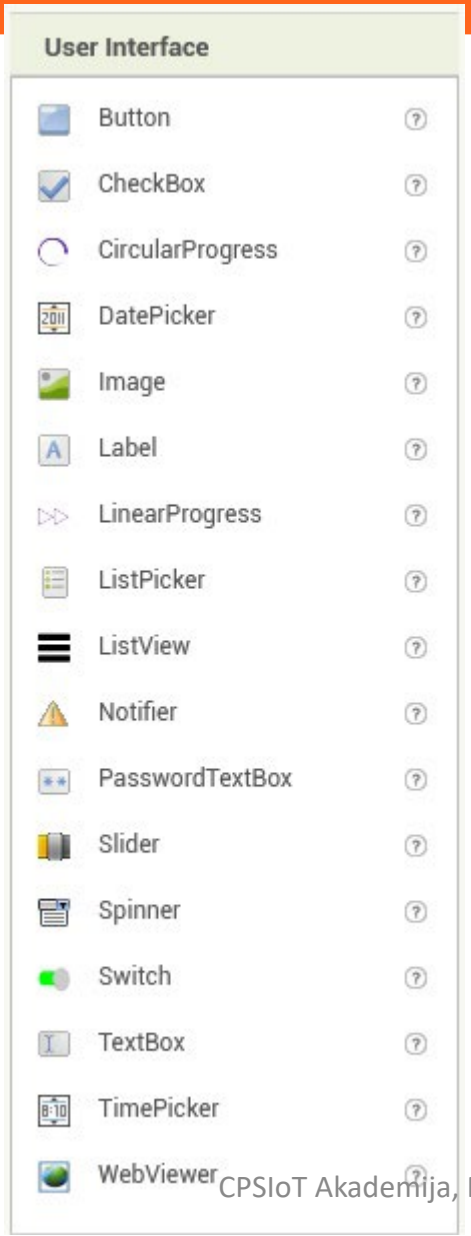


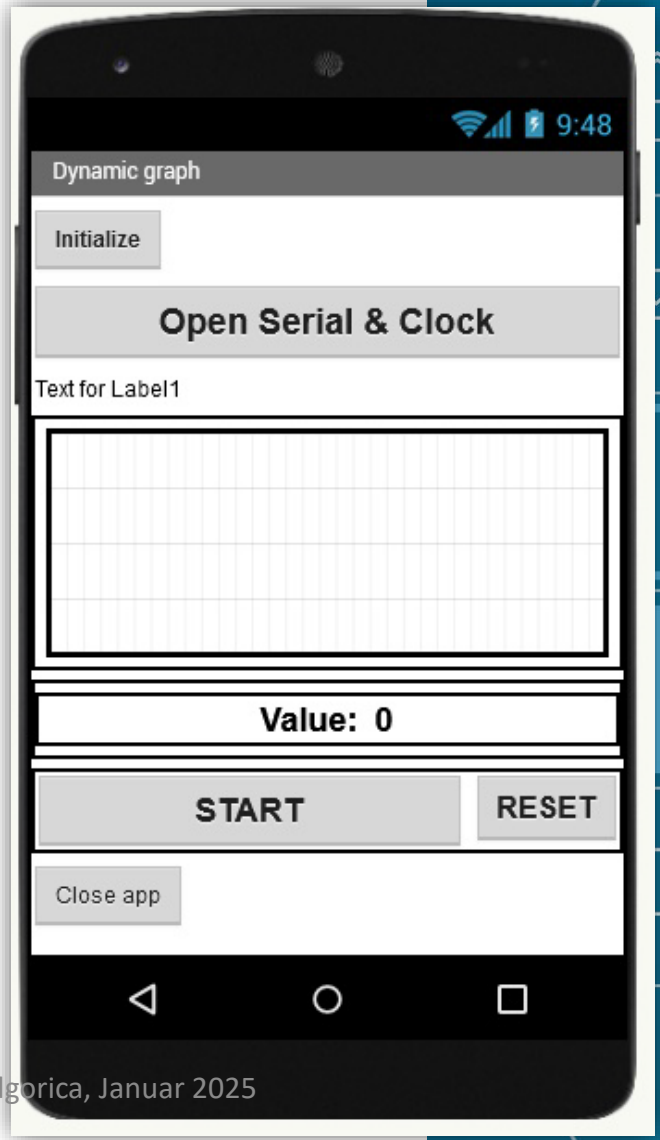
Vizualizacija

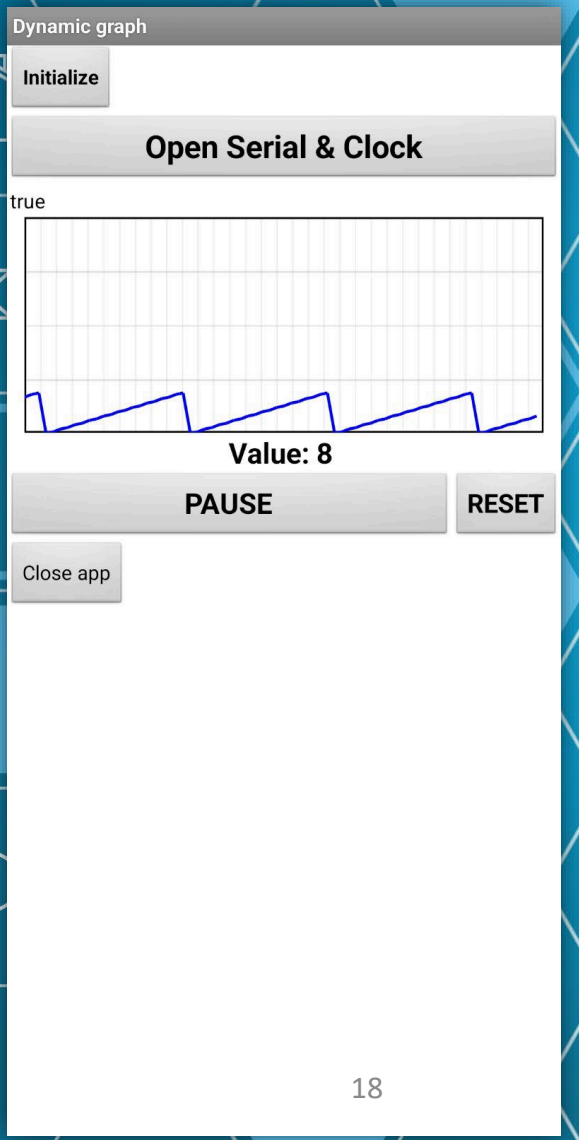
Mobilne aplikacije

- MIT App Inventor

- Bluetooth, Serial, Web
- Testiranje uživo
- Preuzimanje .apk fajla



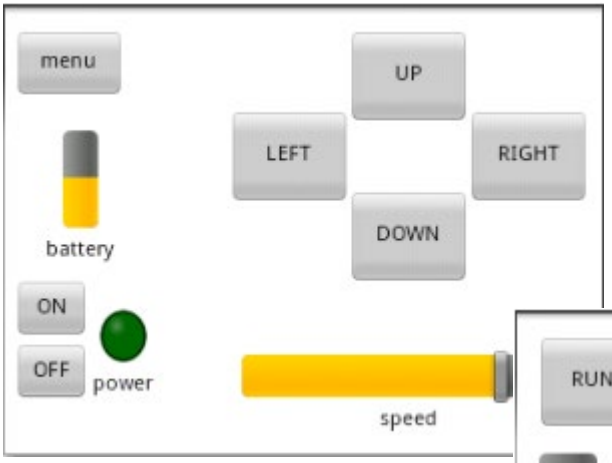


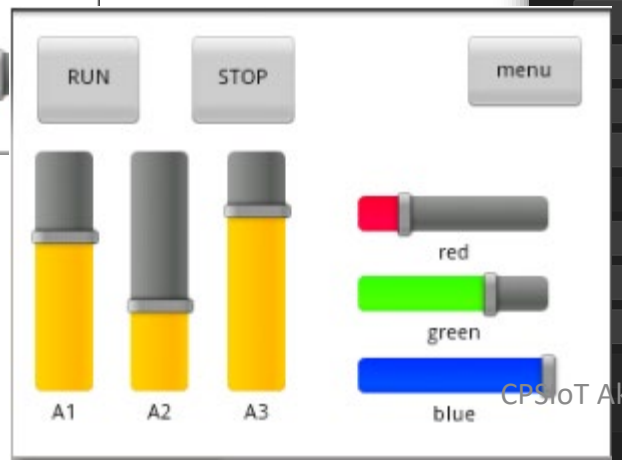


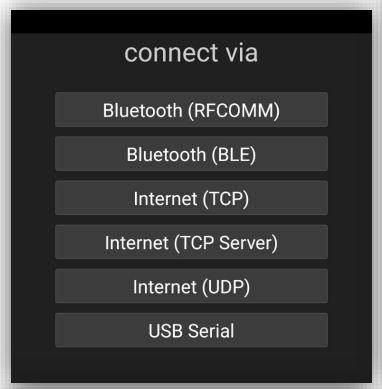
Vizualizacija

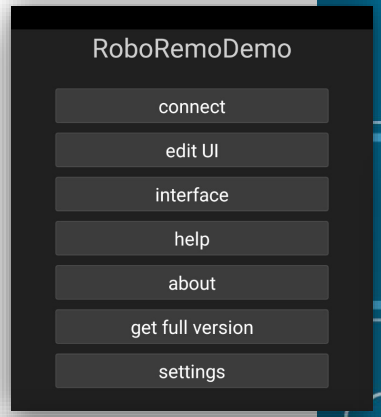
Mobilne aplikacije

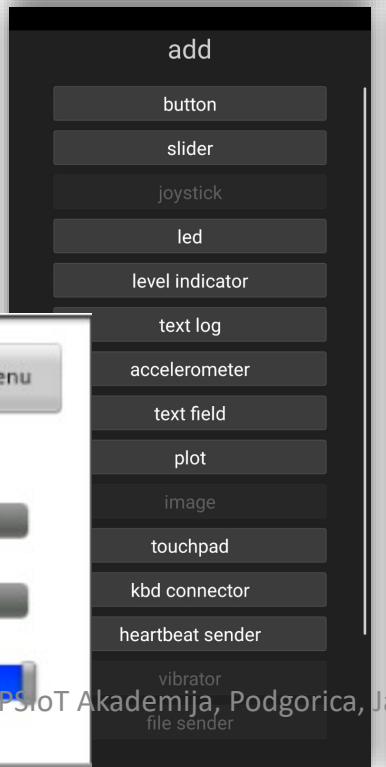
- RoboRemo
  - Razvoj na telefonu
  - Besplatna + platna verzija

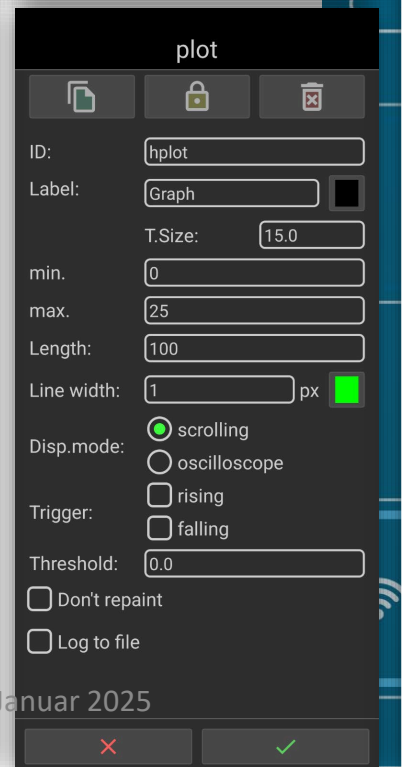


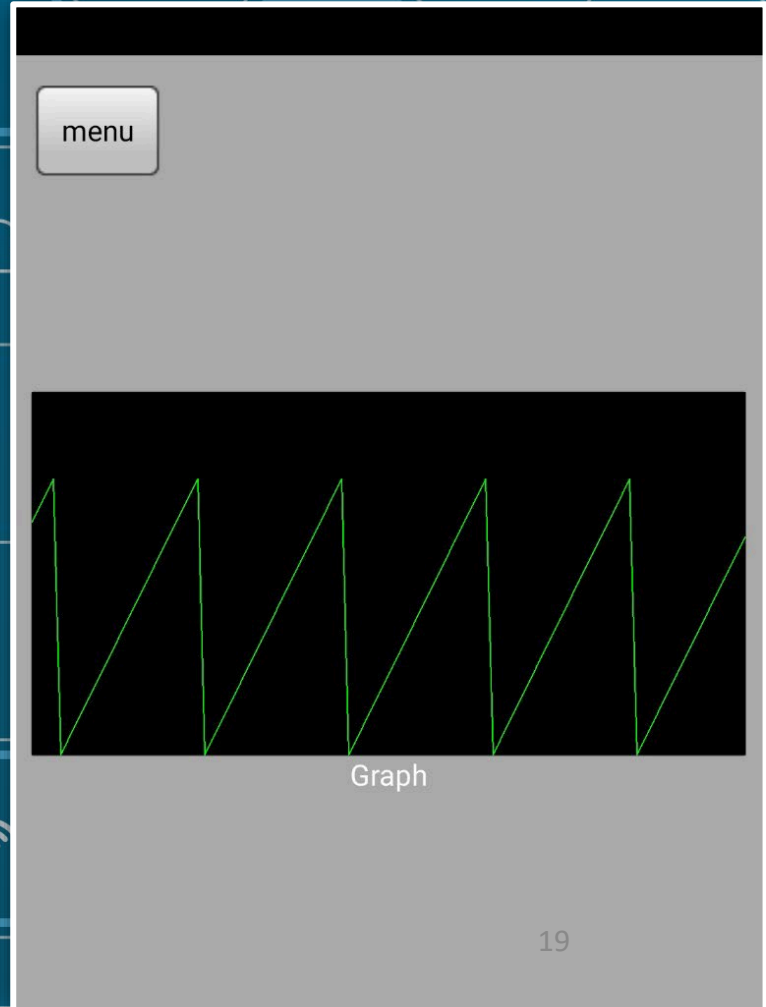












Zaključak

- Komunikacija wearable <-> local host (desktop ili gadget) je veoma važna kako sa stanovišta razvoja sistema i aplikacija, tako i za vizualizaciju i daljnje umrežavanje.
- Njeno projektovanje i realizacija je uslovljena cijenom koštanja, brzinom, količinom podataka, potrošnjom itd.
- Dati su neki primjeri korišćenja žičane i bežične komunikacije.

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Hvala na pažnji, pitanja, komentari?

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