UNIBL-IoT Lab

The objectives of IoT testbed at the premises of University of Banja Luka, Faculty of Electrical Engineering, are to enable various research activities in the area of Wireless Sensor Networks (WSN) and Internet of Things (IoT). Currently, IoT testbed is based on OpenMote-B WSN hardware devices. The OpenMote is a representative of new generation open-hardware platforms that is particularly adapted to Industrial Internet of Things (IIoT) aplications. IoT testbed consists of 25 OpenMote nodes and 4 desktop computers. Desktop computers are used to connect OpenMote nodes to Internet and for purpose of WSN management and processing of measurement data.

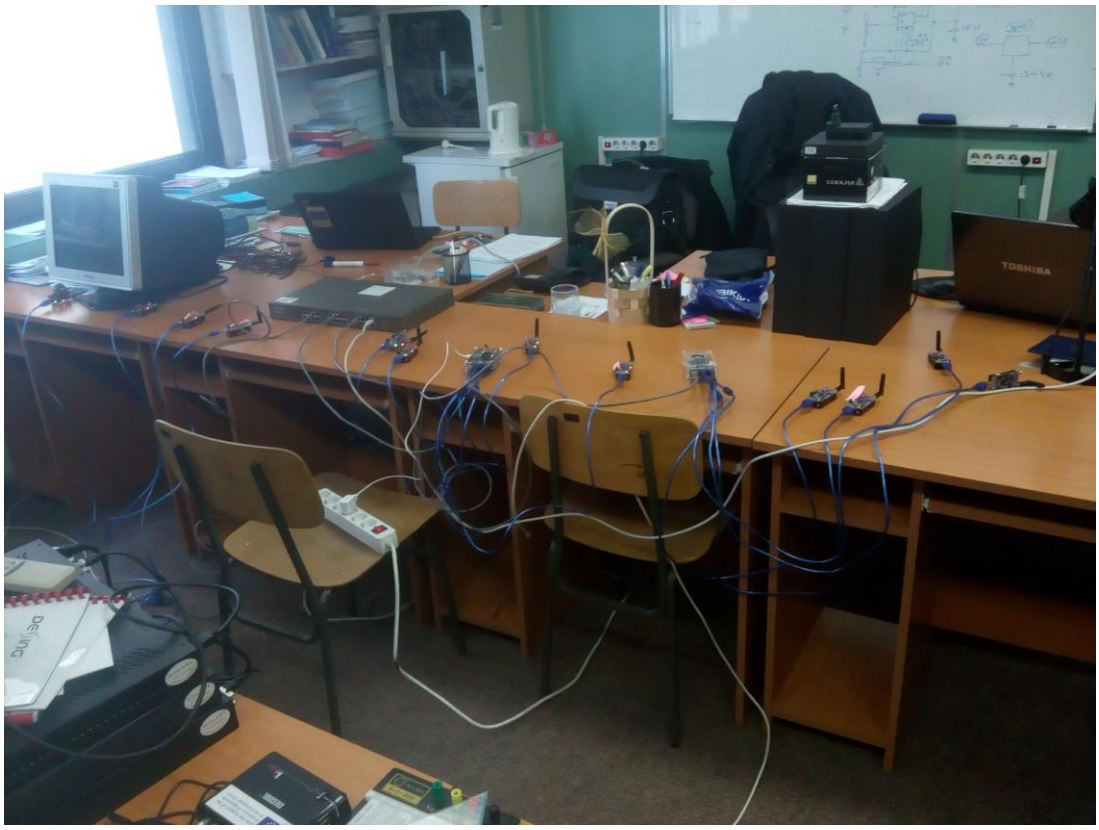


Fig. 1: The OpenMote-based IoT testbed

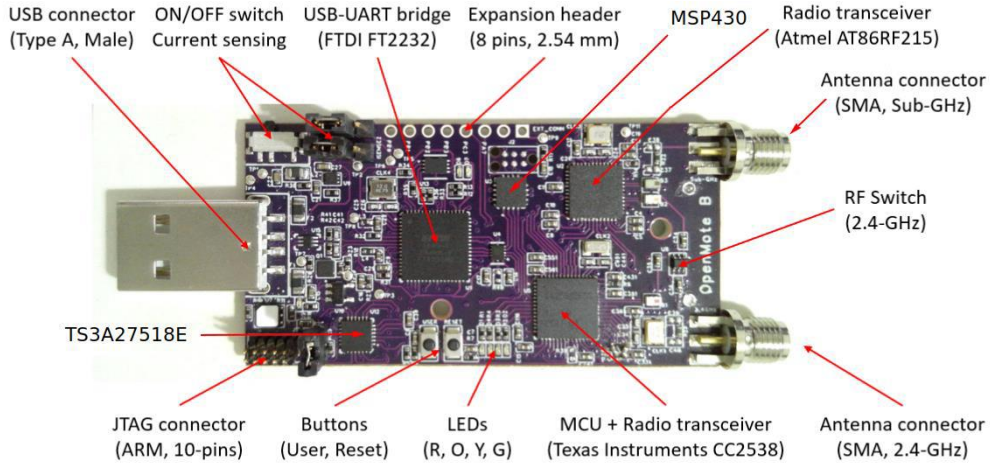


Fig. 2. OpenMote-B hardware.

The OpenMote B is the ultimate hardware development and prototyping platform for the Industrial Internet of Things (IIoT), specifically to researchers and developers working towards next-generation long-range and low-power wireless field area networks based on the IPv6 stack. It is built around the well-supported Texas Instruments CC2538 ARMCortex-M3 micro-controller, and it features simultaneous multi-band operation in the 2.4 GHz and 868/915MHz ISM bands with complete support for the latest IEEE 802.15.4 standards, including the MR-OFDM modulations of IEEE 802.15.4g-2012.

Technical Specifications

- Micro-Controller (Texas Instruments, CC2538)

• ARM Cortex-M3 with code pre-fetch

o Running at 16 MHz or 32 MHz

o 32 Kbytes RAM

o 512 Kbytes FLASH

• On-chip peripherals:

o 4x general purpose, 1x sleep timer

o 1x 12 bit ADC with 8 channels

o 2x SPI, 2x UART, 1x I2C

• Security hardware acceleration:

o AES-128/256/SHA2 encryption

o ECC-128/256 secure key exchange

• Low-power operation:

o Active mode: 7/13mA (16/32 MHz)

o LPM1: 600uA (full retention, 4us wake-up)

o LPM2: 1.3 uA (16 Kbyte RAM retention, 128us wake-up, wake-up from RTC)

o LPM3: 0.4 uA (16 Kbyte RAM retention, 128us wake-up, wake-up from GPIO)

SKU: IS.OMB-001 Rev. 0: 22-08-2019

- Transceiver 1 (Texas Instruments, CC2538)

• Operates in the 2.4 GHz ISM band with support for IEEE 802.15.4-2006

o Modulation: OQPSK with DSSS

o Data rate: 250 kbps

o Receiver sensitivity: -97 dBm

o Transmit power: 7 dBm

o Transmit current: 24 mA at 0 dBm

o Receive current: 20 mA

- Transceiver 2 (ATMEL, AT86RF215)

• Operates in the 868/915MHz and 2.4 GHz ISM bands with support for IEEE 802.15.4g-2012

o Modulation: MR-FSK/OFDM/O-QPSK

o Data rate: 6.25 kbps to 2400 kbps

o Receiver sensitivity: -123 dBm

o Transmit power: 14.5dBm

o Transmit current: 62 mA at 14 dBm

o Receive current: 28 mA

UNIBL-IoT Lab is also equipped with following devices:

RASPBERRY PI 3 - MOD B - 1 GB

Ultimate Starter Kit for Arduino ADA010

ESP8266 ESP-12E UART WIFI Wireless Shield TTL Converter

Ethernet Shield WizNet W5100 R3 Arduino Mega

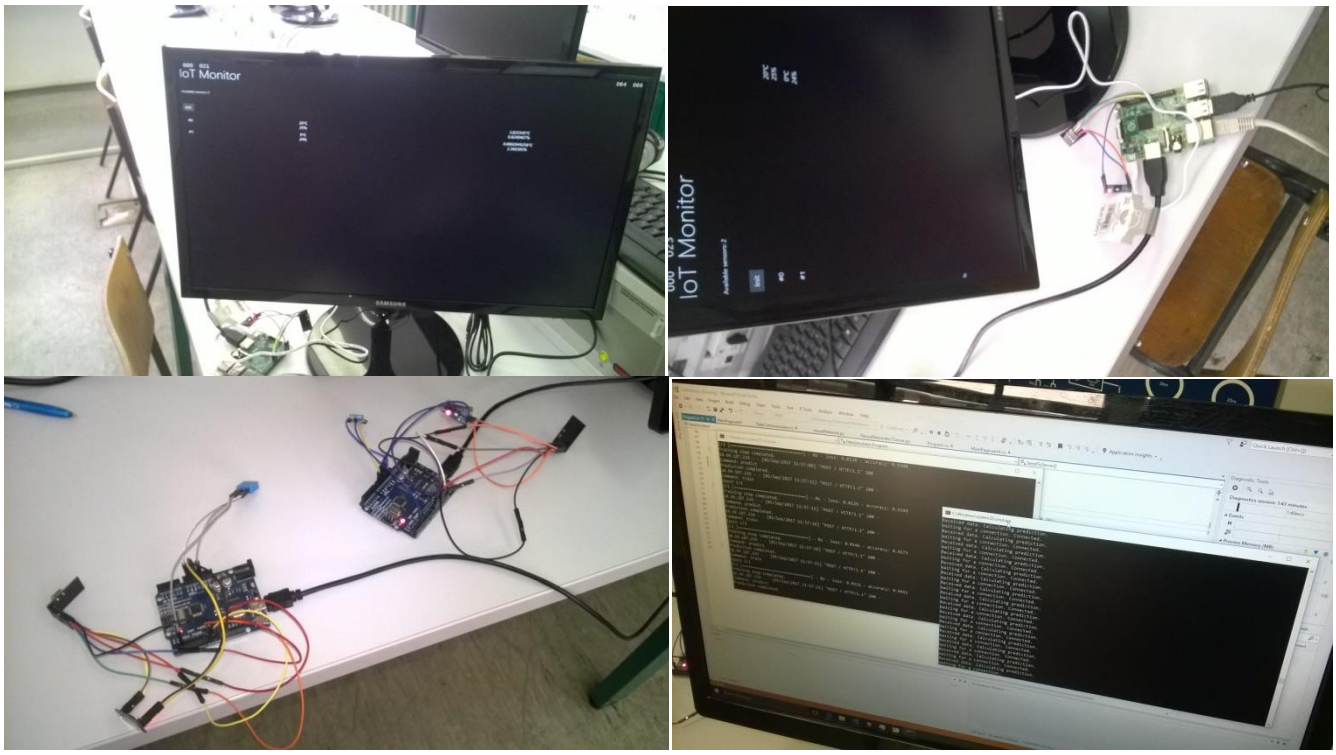
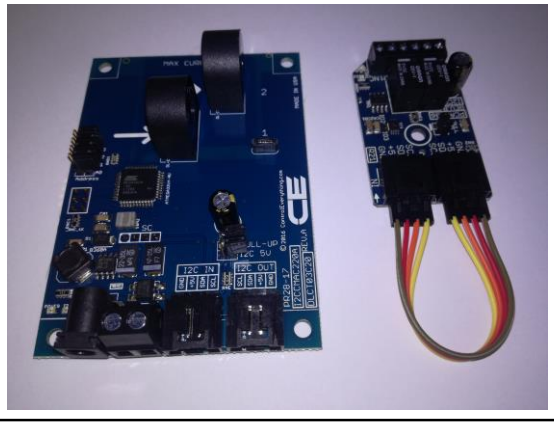
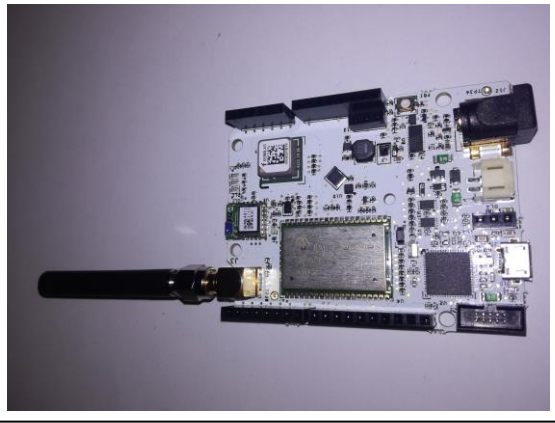


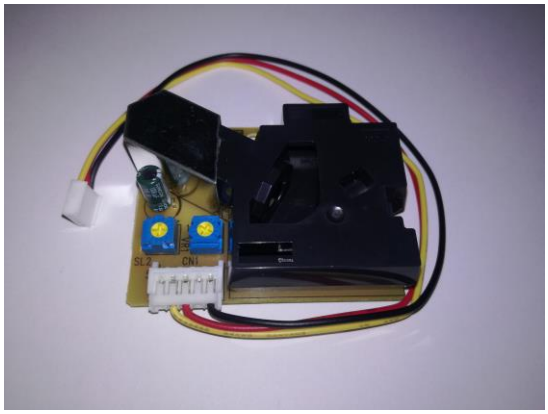
Fig. 5. Raspberri Py and Arduino platforms

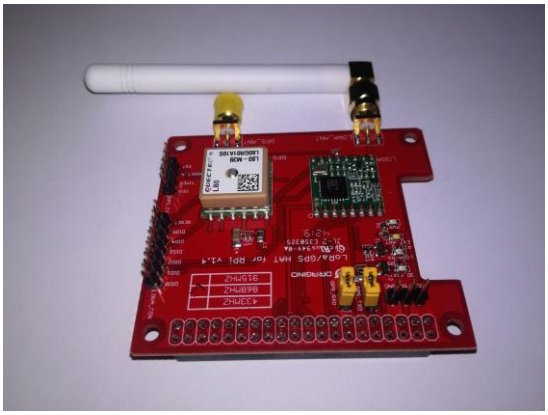
List of equipment
Development board/ Wi-Fi module: CC3200R1M2RGC Single-Chip Wireless MCU
Development board for LoRa technology which supports WAN and LLPWAN protocols with STM32L0;
Evaluation and development kit for LoRA transceivers in 868 MHz
Wireless development board – packet sniffer with USB interface for IEEE 802.15.4 technology
Atmosphere sensor that measures atmospheric pressure from 30 kPa to 110 kPa, temperature and humidity with integrated I2C and SPI interfaces;
Router supporting the following modulations and protocols: 802.11a/b/g/n, Bluetooth, HSPA+, LoRa and has integrated Ethernet and USB interfaces.
(ZigBee) wireless sensor: CM5000;
Energy monitoring Kit which monitors AC current based on plug-and-play
Development (Wi-Fi) board
Dust sensors
Temperature, humidity and pressure sensors
Light sensor
IoT development board compatible with Microcontroller board
Microcontroller board compatible with Intel Quark SoC X1000 processor 32-bit Intel Pentium-class system on a chip
Microcontroller system for wireless (WiFi) connection to Internet

Ethernet Shield for Microcontroller board
NB-IoT and LTE-M developer board with EGPRS fallback
Power supply adapter 220V - 9V (DC)
40x4 LCD Module Display for Microcontroller board
Solderless Breadboard
Male to male dupont wire cables
Male to female dupont wire cables
Lora/ Gps extension board for single-board computer
Lora extension board for Microcontroller board
Ultrasonic Module Distance Sensor
Channel relay board module with Optocoupler 5V(DC)
Wireless RF Transceiver Module for Microcontroller board
IoT kit that includes 10 low-power MEMS sensors
USB-to-TTL serial cable converter
5V-2A Micro-USB charger adapter

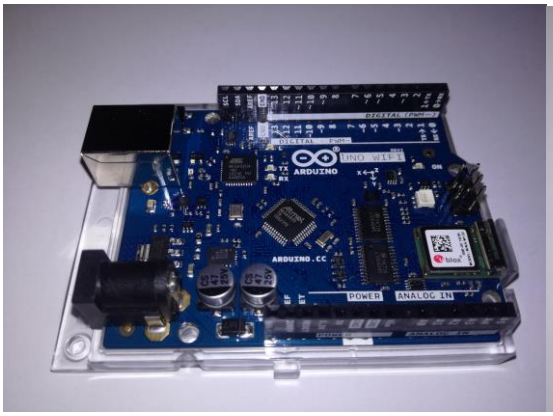









TONGLING
JQC-3FF-S-Z
IN1
IN2
IN3
IN4
GND IN1 IN2 IN3 IN4 VCC


ARDUINO
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LoRa Shield V1.4