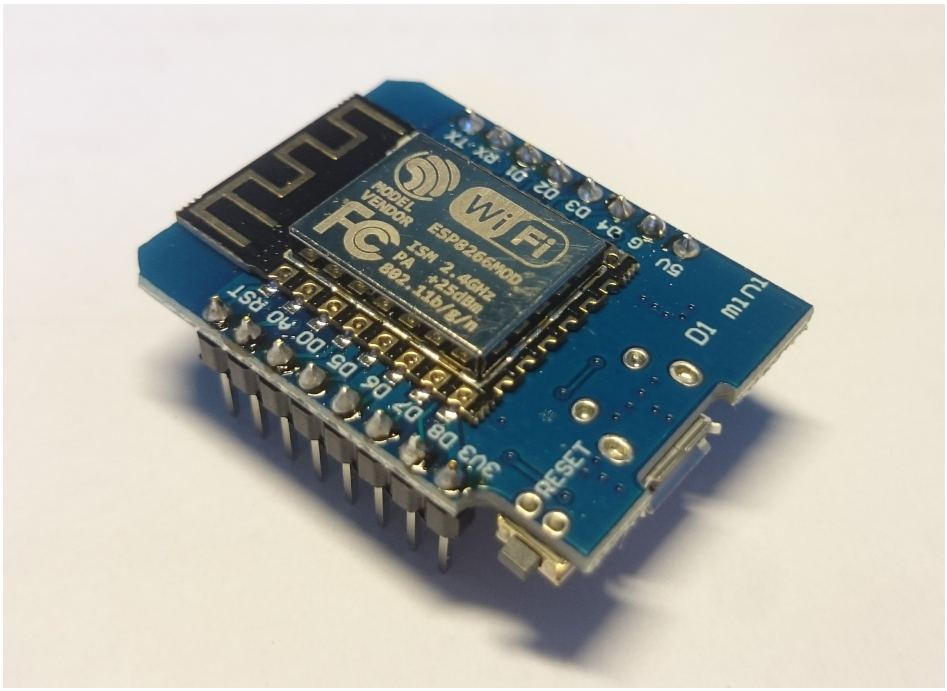
Smart Solutions

LOTI.05.060

WiFi



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Sisukord

WiFi

1 Introduction

Wireless Local Area Network (WLAN) connects the devices to each other in the determined environments like home, school, lab or office, using wireless communication technologies. This gives user the chance to move around this environment with its device maintaining the connection to the network. The special network device called *gateway* routes the local network traffic to the internet ([1]).

Nowadays, most of the local networks base on the IEEE 802.11 [2] standard and market under the Wi-Fi[3] brand.

IEEE 802.11 uses 2.4GHz and 5GHz frequencies as signal carriers. A lot of devices, especially routers can make use of both of them. 5GHz frequency makes possible to avoid overpopulated lower frequency, which is also shared with Bluetooth and microwave owens. Also, the higher frequency band is wider, containing more channels and therefore more active devices at the same time. The standard allows also 3.6GHz and 60GHZ bands.

All the devices in the wireless network are called *stations (STA)*. Every station has *wireless network interface controller (WNIC)*. Wireless stations are divided into *wireless access points (APs, hotspots)* and *clients*. The APs are stationary base stations of the wireless network. AP sends out and receives the signals to communicate to the wiresess devices in the etwork. The clients may be mobile devices like laptop computers, mobile phones, or any other devices having WNICs.

IEEE 802.11 has two modes of operation - infrastructure and *ad hoc*. In the *ad hoc* mode, the communication is established between to devices directly (*peer-to-peer*). In the case of the infrastructure mode, the devices communicate to each other throught the AP, which may also act as a gateway between wired and wireless networks.

Since the wireless network is much more open environment compared to the wired network, the encryption is applied to the communication: Wired Equivalent Privacy (WEP, unsecure by now), Wi-Fi Protected Access (WPA, WPA2).

The network coverage usually depends on the radiation power of the device and the antenna. The usual coverage of a AP having standard antanna might be ca. 100m, 20km with parabolic directional antenna.

Wi-Fi has higher demand for the supply power compared to other standards. The Bluetooth has small coverage (1-100m), but also small demand for the energy. ZigBee with small energy demand has relatively large coverage but smaller transfer speed. The increased need for the energy is usually the problem while powering the Wi-Fi devices from the portable power supplies like batteries.

The present guide is designed for the course LOTI.05.060 "Smart Solutions" of Tartu University and available at
https://ims.ut.ee/~marvin/nutipraks/

1.1 Safety

1 **The SD slot of RasPi 2 has a lock. Please push the card against the bottom while inserting it to or releasing it from the slot until your hear the click. Direct pull from the slot will destroy the lock resulting in malfunctioning slot. The mobile devices use the same type of card slots.**

2 **The devices used in the practical works are sensitive to the static electricity. Please ground yourself before touching the electronics by touching a big volume metallic object or ground yourself to it via special cable you can get from the supervisor.**

3 **The first rule of every electric circuit: to not make connections to the powered devices. Therefore, please switch your RasPi off before connecting an another device to it.**

4 **Never insert anything but the standard plug into the 230 volt wall outlet.**

5 **The output and input voltage of Raspberry Pi's GPIO is 3.3V. The output and input voltage of Arduino Nano GPIO is 5V. The input-output voltage of the data pins of the Bluetooth modules is 3.3V. Please use the level-shifter then connecting the devices with different input-output voltages. Show the circuit to the supervisor before powering.**

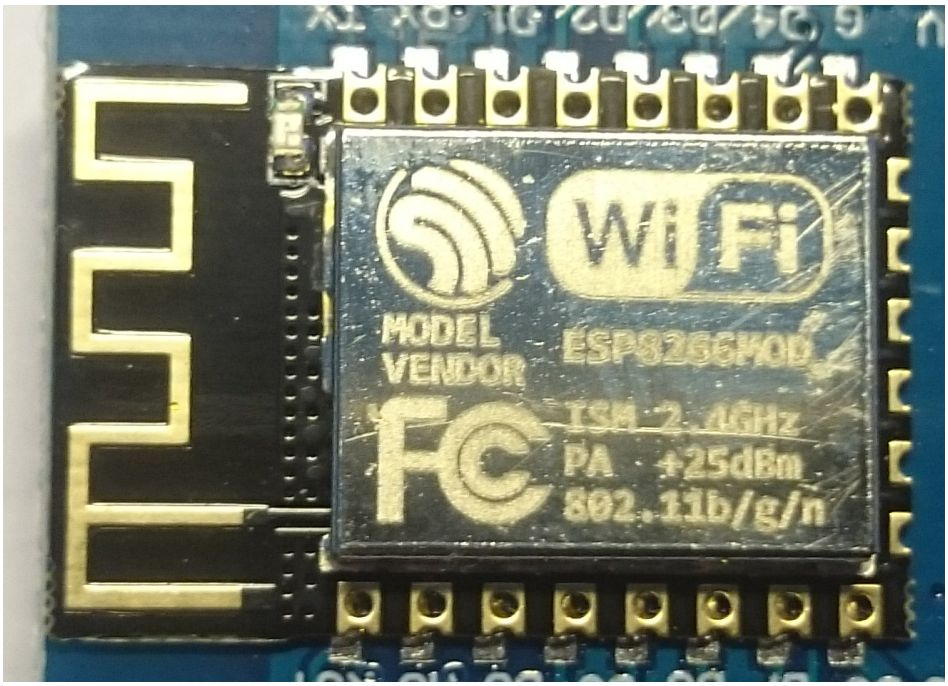
6 **Please do not include the relays covered in the practice in your domestic or other 230 or 400 volt AC power grids. In 230 and 400 volt AC power grids, only qualified electricans may carry out switching and installation works. Present course does not, under any circumstances, confer the competence to make circuits and installations in 230 volt and 400 volt AC power grids.**

7 **Please place all the electronics and electric components, what have pinheaders, to the breadboard while making circuits. This avoids accidental short circuit of the pins.**

2 ESP8266EX

ESP8622EX [4] is a *System-on-a-Chip (SoC)*(joonis **1**, produced by the Chinese company called Espressif [5]. The system by it's nature is a complete and standalone solution for the Wi-Fi networks. It can be used as a network server or a client. Also, it can be used to run standalone applications from the external flash memory.

Features [4]:



Joonis 1: ESP8266EX

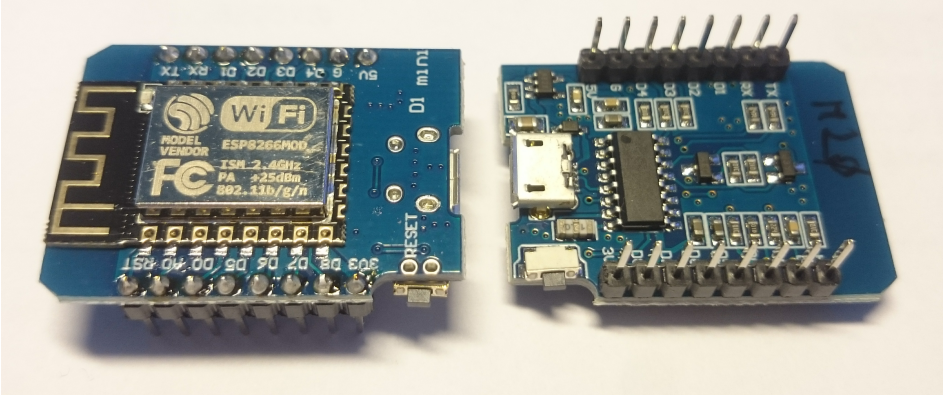
- 802.11 b/g/n;
- integrated low-power 32 bit RICS microcontroller (Tensilica L106), 80-160MHz;
- integrated 10 bit ADC;
- integrated TCP/IP stack;
- WiFi 2.4GHz, WPA/WPA2 support;
- STA/AP/STA+AP modes;
- SDIO 2.0, (H)SPI, UART, I2C, I2S, IR, PWM, GPIO.

3 Wemos D1 Mini

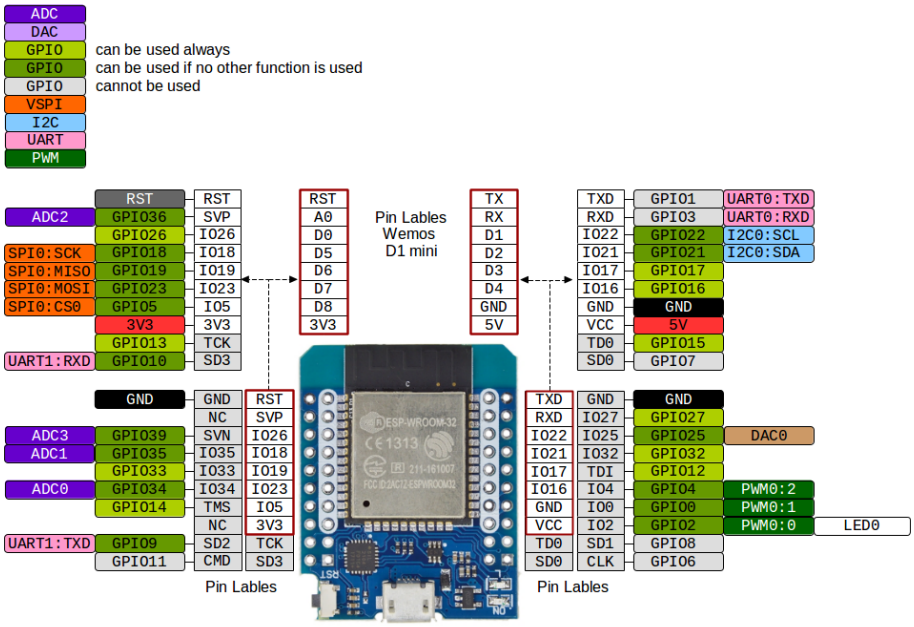
Wemos D1 Mini [6] is an ESP8266EX based miniature Wi-Fi development board (joonis **2**) by WEMOS Electronics [7] with 4 MB flash memory.

Features [8]:

- microcontroller: Tensilica 32 bit RISC CPU Xtensa LX106;
- operating voltage: 3.3V;
- input voltage: 7-12V;



Joonis 2: Wemos D1 Mini



Joonis 3: Wemos D1 Mini pinout

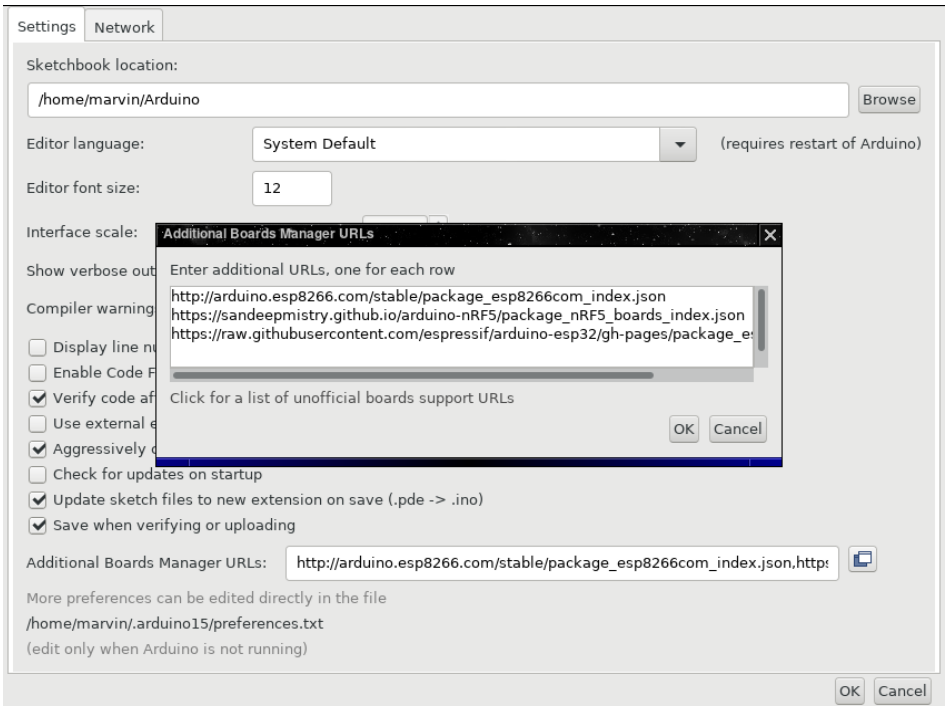
- digital input-output pins (DIO): 11 (joonis **3** [9]);
- analog input pins (ADC): 1;
- UART: 1;
- SPI: 1;
- I2C: 1;
- flash memory: 4MB;
- SRAM: 64kB;
- clock speed: 80MHz;
- WiFi: IEEE 80211 b/g/n (WEP, WPA/WAP2 or open network).

Tabel 1: Wemos D1 Mini pinout

Pin	Function	ESP8266 pin
TX	TXD	TXD
RX	RXD	RXD
A0	analog input, **max. 3.3 V**	A0
D0	IO	GPIO16
D1	IO, SCL	GPIO5
D2	IO, SDA	GPIO4
D3	IO, 10kOhm pull-up resistor	GPIO0
D4	IO, 10kOhm pull-up resistor, BUILTIN_LED	GPIO2
D5	IO, SCK	GPIO14
D6	IO, MISO	GPIO12
D7	IO, MOSI	GPIO13
D8	IO, 10kOhm pull-down resistor, SS	GPIO15
G	ground	GND
5V	5V	-
3V3	3.3V	3.3V
RST	reset	RST

All IO pins have interrupt/PWM/I2C/1-wire support, except D0. **All** IO pins work at *3.3 V*.

The board is powered either by the external 6-12V power supply via VIN (5V) pin or onboard Micro USB B socket. The UART serial connection is converter to USB by the onboard CH340 chip.

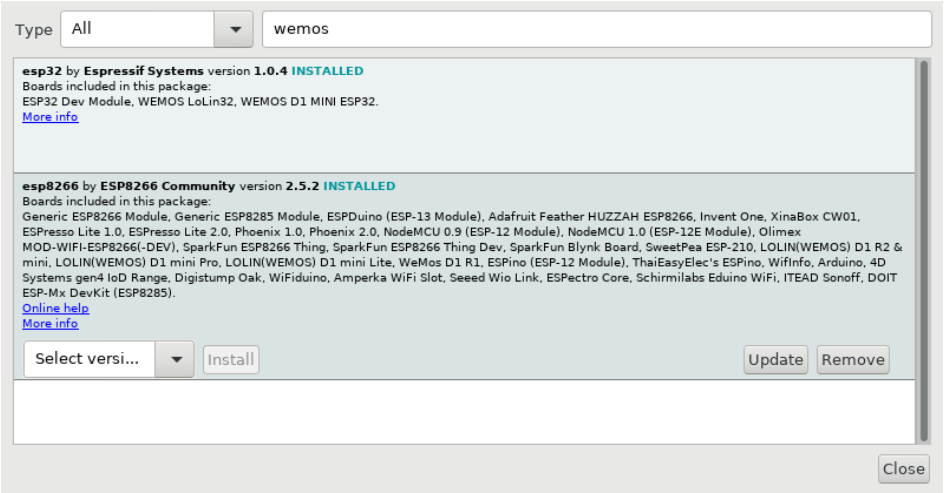


Joonis 4: Adding the address of the development board description to Arduino IDE

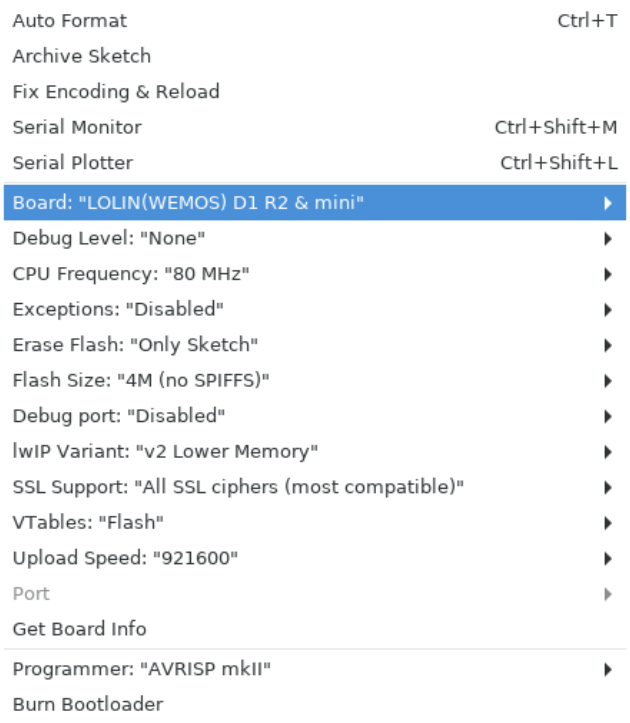
4 Wemos D1 Mini and Arduino IDE

By default, the Arduino IDE does not have the information about the Wemos D1 Mini. To introduce this board to Arduino IDE, open *Preferences* window, available via **File–>Preferences**. Add the address *https://arduino.esp8266.com/stable/package_esp8266com_index.json* (joonis **4**) into the *Additional Boards Manager URLs* cell. Multiple addresses are separated by the coma. The button on the side open also the window containing the address list.

Next, find the *Boards Manager* under **Tools–>Board: –>Boards Manager...**. Search for “wemos” and install “esp8266” (joonis **5**). If the board is connected to the computer via USB cable, then choose the right board under **Tools–>Board:** *(LOLIN) Wemos D1 D2 & Mini* (joonis **6**).



Joonis 5: Installing the board description



Joonis 6: Activating the board

Viited

[1] https://en.wikipedia.org/wiki/Wireless_LAN.

[2] https://en.wikipedia.org/wiki/IEEE_802.11.

[3] https://www.wi-fi.org/.

[4] https://www.esp8266.com/wiki/lib/exe/fetch.php?media=0a-esp8266_datasheet_en_v4.3.pdf.

[5] https://www.espressif.com/en.

[6] https://wiki.wemos.cc/products:d1:d1_mini.

[7] https://wiki.wemos.cc/start.

[8] https://docs.zerynth.com/latest/official/board.zerynth.wemos_d1_mini/docs/index.html.

[9] https://farm6.staticflickr.com/5538/31535351555_d7e1ac3a98_o.jpg.