Weather Station

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1. Weather Station

A weather station is a device that enables monitoring of the weather conditions prevailing around the station, as well as the current time and date.

2. Weather Station Functions

The device allows reading the time (hh:mm) and the date (dd:mm:yy). It is also possible to set a new date and time at any moment. The station additionally displays the current temperature, atmospheric pressure, air humidity, altitude, and detects whether it is raining.

3. Station Components

The weather station is built from the following components:

1. Arduino Uno
2. 16x2 LCD display
3. Breadboard
4. DS3231 real-time clock module
5. Pololu LPS331AP pressure and altitude sensor
6. DHT11 temperature and humidity sensor
7. YL-83 rain sensor

4. Construction Costs

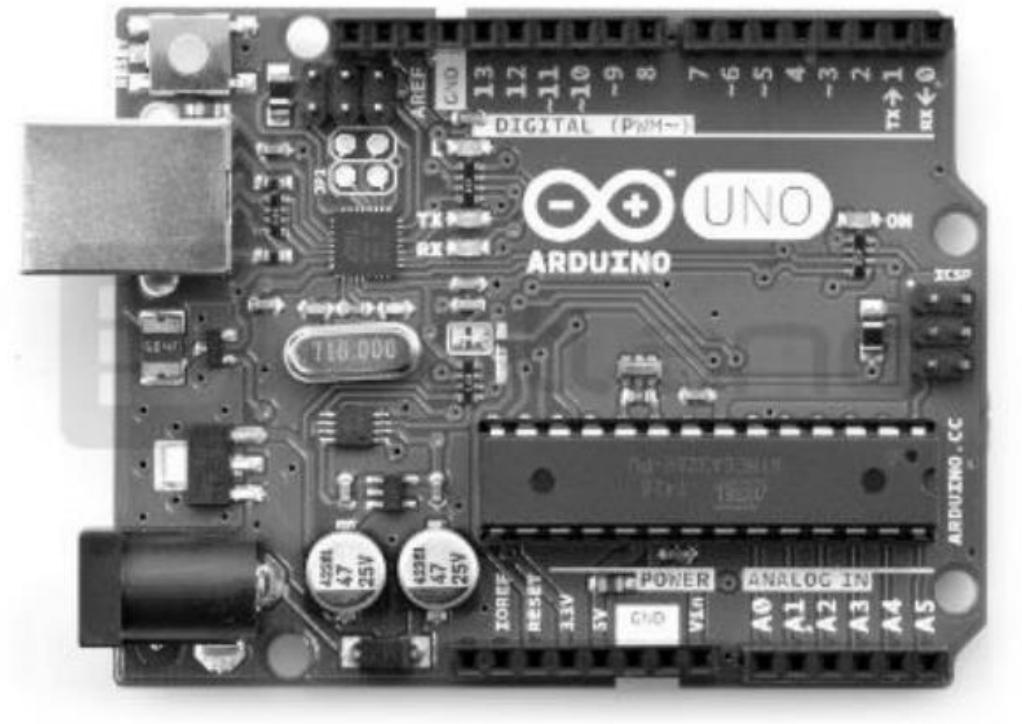
Name	**Price**
Arduino Uno	30
Breadboard	10
LCD display	10
Time module	10
Pressure and altitude sensor	23
Rain sensor	8
Humidity and temperature sensor	8
Other	10
TOTAL	109

5. Component Specifications

Arduino Uno

The Arduino Uno is the basic and at the same time the most popular version in the entire series. The board is equipped with an ATmega328 microcontroller, featuring 14 digital input/output pins, 6 of which can be used as PWM outputs (e.g. for motor control), as well as 6 analog input pins.

The system is clocked by a 16 MHz signal and provides 32 kB of Flash program memory and 2 kB of SRAM memory.



Specifications:

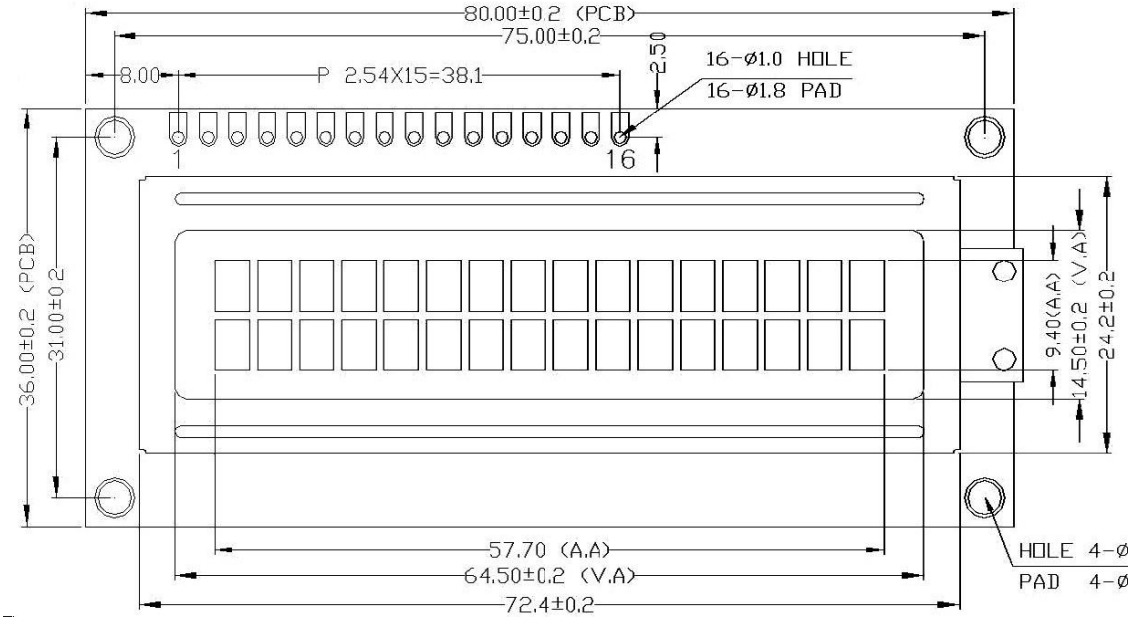
- Supply voltage: from 7 V to 12 V
- Microcontroller: ATmega328
  - Maximum clock frequency: 16 MHz
  - SRAM memory: 2 kB
  - Flash memory: 32 kB (5 kB reserved for the bootloader)
  - EEPROM memory: 1 kB
- I/O pins: 14
- PWM outputs: 6
- Number of analog inputs: 6 (A/D converter channels with 10-bit resolution)
- Serial interfaces: UART, SPI, I2C
- External interrupts
- On-board LED connected to pin 13
- USB Type-A connector for programming
- DC power jack 5.5 × 2.1 mm

LCD Display

A popular alphanumeric LCD display powered by a 5 V supply. It is characterized by simple operation, wide availability, and extensive support for many microcontrollers.

Parameters:

- LCD display: 2×16 characters
- Controller: HD44780 compatible
- Display type: blue negative
- Backlight: white LED backlight, white characters
- Module dimensions: 80 × 36 × 12 mm
- Character dimensions: 2.45 × 5.00 mm
- Operating temperature range: from −20 to +70 °C



The LCD display is controlled in 4-bit mode without reading the busy flag. Data transmission requires four data bus lines and three control lines (RS, E, RW).

The most commonly used communication method is the 4-bit mode without busy-flag reading. Sending half a byte makes it possible to save valuable microcontroller I/O pins—only four data lines are used (in 8-bit mode, eight lines are required). The lack of busy-flag reading necessitates the use of software delays, but it allows saving an additional line—R/W. This pin can be permanently connected to ground, as data are transmitted only in one direction, to the display.

No.	Name	Description
1	VSS	Ground
2	VDD	+5 V power supply
3	V0	Contrast adjustment
4	RS	Selection of the instruction register (low state) or data register (high state)
5	R/W	Read (low state) / Write (high state)
6	E	Display enable
7	DB0	Data bus
8	DB1	Data bus
9	DB2	Data bus
10	DB3	Data bus
11	DB4	Data bus
12	DB5	Data bus
13	DB6	Data bus
14	DB7	Data bus
15	LEDA	Backlight power supply +5 V
16	LEDK	Backlight ground

Breadboard

A breadboard is used for creating and testing electronic circuits without the need for soldering. Strips (blue and red) indicating power polarity make designing easier.

S3231 Real-Time Clock Module

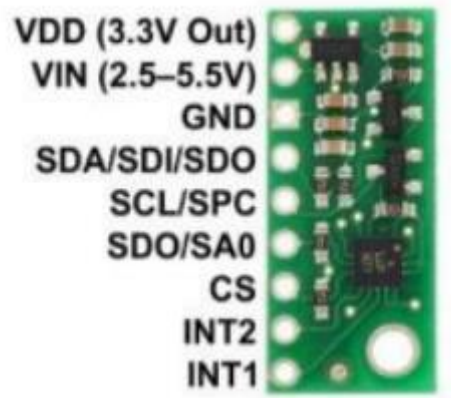
A module with a real-time clock and backup battery power (battery included). It allows reading the time in hours, minutes, and seconds, as well as the date: month, day, and year. The device is based on the DS3231 chip, and the communication interface is the I2C bus.

Specifications:

- Supply voltage: 2.3 V to 5.5 V
- Current consumption: from 200 µA (standby mode 840 nA)
- Controller: DS3231 (documentation available)
- Communication: I2C bus (SDA, SCL)
- Bus address: 0x68
- Provides: seconds, hours, minutes, months, weekdays, and years
- Accuracy:
  - Temperature 0 °C to +40 °C: ±2 ppm
  - Temperature -40 °C to +85 °C: ±3.5 ppm
- Connectors: soldered female 2.54 mm pin headers – compatible with goldpin strips
- Backup battery power
- Battery is included and permanently mounted; changing it requires a soldering iron
- Board dimensions: 18 × 18 × 18 mm (with connectors)

Pololu LPS331AP Pressure and Altitude Sensor

Module containing the ST MEMS pressure sensor LPS331AP. The board also includes necessary passive components and a low-dropout voltage regulator, allowing the sensor to operate with 3.3 V or 5 V systems. The LPS331AP chip has integrated temperature compensation and many configurable options, including selectable resolution and two programmable external interrupts. The sensor operates in the range of 26 kPa to 126 kPa with an accuracy of 0.2 kPa. In the highest resolution mode, noise levels are 0.002 kPa. The communication interface is either I2C or SPI.



Specifications:

- Supply voltage: 2.5 V – 5.5 V
- Current consumption: 2 mA
- Communication interface: I2C (TWI) or SPI
- Data format: 24-bit
- Measurement range: 26 kPa to 126 kPa
- Dimensions: 22.86 × 10.16 × 2.54 mm
- Weight: 0.6 g (without connectors)

The sensor has nine pins for mounting goldpin headers – 2.54 mm pitch (included). Upon customer request, we can solder the header. Power in the range of 2.5 V to 5 V should be connected to the VIN and GND pins. When using a 3.3 V system, the VIN pin can be left unconnected, and power should be supplied directly to the sensor through the VDD pin.

The device communicates via a digital interface, either I2C or SPI. The logic voltage of the bus signals should match the supply voltage connected to VIN. When using the I2C bus, connect the SCL and SDA pins. For SPI communication, four pins need to be connected: SDI, SDO, SPC, and CS.

DHT11 Temperature and Humidity Sensor

A popular temperature and humidity sensor in a through-hole package. The device can be operated using a microcontroller.

Specifications:

- Supply voltage: 3 V to 5.5 V
- Average current consumption: 0.2 mA

Temperature:

- Measurement range: 0 – 50 °C
- Resolution: 8-bit (1 °C)
- Accuracy: ±1 °C
- Response time: 6 – 15 s (typically 10 s)

Humidity:

- Measurement range: 20 – 90 %RH
- Resolution: 8-bit (±1 %RH*)
- Accuracy: ±4 %RH* (at 25 °C)
- Response time: 6 – 30 s

DHT11 Pin	**Arduino Pin**
VCC	5 V
DATA	e.g., 2
GND	GND

YL-83 Rain Sensor

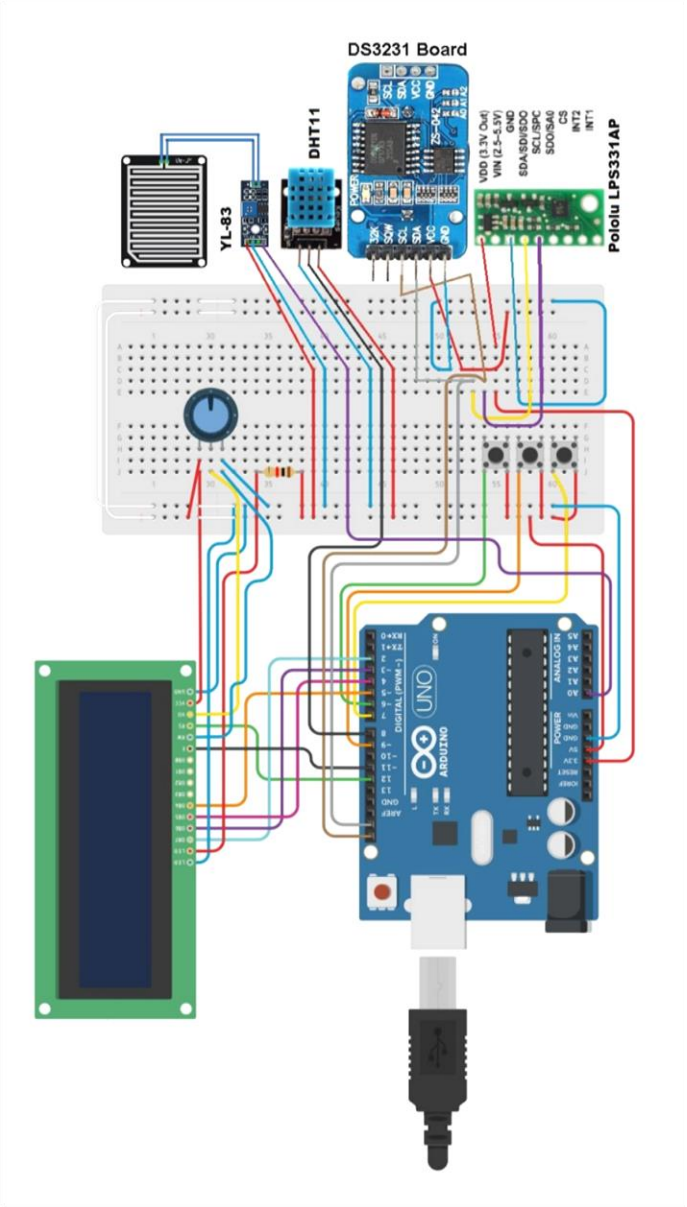
The sensor is used to detect rainfall. It operates at 5 V and provides both digital and analog outputs.

Specifications:

- Supply voltage: 5 V
- 1 × digital output
- 1 × analog output
- Sensitivity adjustable via potentiometer
- Digital output current capacity: max. 100 mA
- Two status LEDs indicating power and rainfall detection
- Main module dimensions: 30 × 16 mm
- Sensor board dimensions: 54 × 40 mm

The device consists of three parts: the sensor probe, the detector module, and connecting wires. The probe should be connected to the main module using the wires. The potentiometer on the module allows adjustment of the sensor's sensitivity. The sensor has a digital output D0 that signals the occurrence of rainfall. When rain is detected, D0 switches from a high to a low state. The sensitivity, i.e., the voltage threshold, can be adjusted using the potentiometer. The D0 output can be connected directly to a microcontroller or a development board. The sensor also has an analog output A0, which should be connected to an A/D converter input. This output allows reading the measured intensity of rainfall. Two LEDs are located on the board: a green LED indicating proper power connection, and a red LED indicating the detection of rain.

6. Connection Diagram



7. Program Code

The program is available at:
https://github.com/maciejnalewajka/Weather-Station

Main functions:

- loop() – runs the program in a loop
- dane() – reads data from the sensors
- god() – reads the time and date from the real-time clock module
- setTime() – sets the time and date for the real-time clock module
- widok() – configures the display view of the information

8. Bibliography

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