**balbalbl**

**Concept and motivation:**

My main motivation was to create some useful device, one that is not just a simple program but something that can be built manually. I found the Mr. Tokarz's topic and I found it very interesting. I really wanted to make a device that can be useful in my everyday life and that will be easy to modify in the future.

I have a bit of experience in programming in Arduino, using sensors and microcontrollers. I did it only as a hobby and I do not have a lot of knowledge in this subject, so I decided that an engineering project would be the best chance to learn something new in that case.

I really liked the idea of a device that will be wireless and will send data via the WiFi module.

**Project specification:**

Project description:

The goal is to create an outdoor device with a set of sensors covering the light conditions, temperature, pressure, humidity, rain drops and noise detection. The device should be powered with the solar panel and equipped with the rechargeable battery.

The device should send data with some energy-efficient wireless protocol to the receiving device that re-sends data using WiFi with MQTT protocol.

My work plan of the project is:

1. Subject analysis

2. Review of existing solutions

3. Literature studies

4. Project development

5. Implementation

6. Testing and validation

7. Preparation of technical documentation and work description

**Project specification - Components**

I decided to use sensors:

**Microcontroller ESP8266MOD Nodemcu**

WiFi module based on ESP8266 has NodeMCU software preloaded. The system is equipped with 10 GPIO pins, which means general purpose input-output (each of them can be controlled by pulse width modualtion signal), I2C communication (transmission which uses two bi-directional lines: SDA - Serial Data Line and SCL - Serial Clock Line, 1-Wire communication, 10-bit analog-to-digital converter and PCB antenna – which allows to use WiFi communication. In addition, the board has a USB-UART (CH340) converter, which allows you to program ESP8266 directly via the USB port using the Arduino IDE environment.

**Next about Rain sensor YL-83**

The device consists of three parts: the measuring probe, the detector module and the wires. The probe should be connected to the main module with wires. The potentiometer placed in the module allows me to adjust the sensitivity of the sensor.

This is one of the simplest and most accurate methods of detecting rainfall is the use of a resistive comb sensor. Its design is based on two systems of conductive paths, isolated from each other and placed at a short distance.

The shape of the overlapping combs makes it possible to detect even small, single raindrops, which cause a decrease in the sensor resistance. This effect can be easily detected with a simple voltage comparator that produces a binary output signal depending on the state of the sensor (in this case, low means rain has been detected).

**ISL29125 light intensity sensor RGB I2C SparkFun SEN-12829**

The module measures the intensity of RGB light, separately for red, green and blue. For example, when the measurement is made for blue, the relevant filter cuts off red and green. It is supplied with the voltage of 3.3 V and communicates via the I2C interface

---RH to relative humidity---

**BME280 - humidity, temperature and pressure sensor 110kPa I2C/SPI - 3,3V**

It is easy sensor powered with the voltage of 3.3 V. It communicates via the I2C interface. The BME280 sensor is able to measure the temperature with an accuracy of +/- 1 celcius degree in the range from 40 oC to +85 oC.

The range of humidity measurement is from 10% to 100% (accuracy +/- 3% RH),

and in the case of pressure, the range is 300 hPa to 1100 hPa and the accuracy is +/- 1 hPa.

**Noise detector - Analog sound sensor - Waveshare 9534**

Module with sound sensor equipped with analog and digital outputs. It is supplied with the voltage in the range from 3.3 V to 5.3 V. It enables the detection of the volume level or the detection of characteristic sounds from the environment, eg clapping.

I think in my project I will use it for detection of loud lightning discharges . But there is not many storm in winter, so it will just detect higher sound frequencies

**Solar power module DFrobot (output 90mA)**

The module allows to charge the Li-pol battery with a voltage of 3.7 V using the included mini solar cell or microUSB port and powering the devices with 3.3 V. All modules of the device have the algorithm, which greatly increases efficiency under changing conditions. The board is also equipped with a number of protections - against overcharging, discharge and reverse connection of the battery.

**Rechargeable battery cell 18650 li-lon**  
The cell was made in the modern Li-ion technology

**Advantages:**

• Multiple Use - the manufacturer guarantees 1000 charges.

• Wide Application - Home electronics powered by a single cell.

• THE MOST IMPORTANT THING IS No Memory Effect - the rechargeable batteries can be charged whenever you want, without any side effects.

**Project specification diagram:**

This is my basic project diagram consisting of main components of my future weather controller. I created it so that I could show my project to the professor and discuss the details with him

In case of communication it will be:

**MQTT**

MQTT (Message Queuing Telemetry Transport) - based on publication / subscription pattern, extremely simple, data transmission protocol. It is intended for transmission for devices that do not require high bandwidth (BANDŁIF). By limiting the transmission speed, the protocol provides greater reliability. This protocol is ideal for machine-to-machine connections, Internet of Things (IoT), mobile devices, and where energy savings are required.

**My engineering project for now**At the moment my project - or rather component testing, looks like this. For now, it is connected only on the breadboard, but in the future, of course, I will try to create my own design of a PCB board, to which all sensors can be easily connected. The board will also have special hooks allowing it to be permanently attached to the future container.

**Testing**

Testing my project will consist of several separate tests in different weather conditions, e.g. when it is sunny, rainy or cloudy. However, it seems to me that at the beginning it will be worth simulating the appropriate weather conditions by myself. Most likely it will be such that:

* the light intensity will be simulated with a specific light source of different colors,
* temperature - closer or further to the heat source of course,
* humidity - I have an air humidifier at home so it will be a good way to use it,
* the pressure sensor is easy to check by setting it in places at different heights - it is very accurate,
* rain drops - the sprinkler for flowers will be perfect
* the noise detector is actually an ordinary microphone so testing it will not be complicated.

It is also worth adding that one of the main aspects of testing will be taking appropriate measurements of the current consumption. It is important that the device can operate regardless of weather conditions as long as possible without being recharged from a physical power source. The tests will also be focused on checking after what time the device will discharge - whether I can, for example, leave it for the whole day, which is only slightly sunny and it will charge well enough to work until the next sunrise. It will also be worth checking how such an experiment relates to my theoretical calculations, because many external factors, primarily temperature, affect the battery life and power consumption of the sensors.

An important element of testing will also be the operation of the device in various containers, as well as the use of various methods of isolating components that are exposed to easy breaking up.

I think that the device, in case of cost which will be around two hundred and fifty zlotys, will not be so perfect that the measurements from it will be very accurate and the power consumption will not change too much over time. I think that the vision that the device can be left outside for a few days without thinking about recharging will not be so easy to implement. Therefore, in the project I will want to focus on the appropriate power consumption research and describe the conditions under which an ideally made device will be able to work as it should.

**Use-cases**

The main use case is to control the weather conditions and the ability to receive them on the server I set up. It will be a one-way communication so the user will not be able to influence the type of information he receives on the server because it will be precisely programmed on the board. But in the future, perhaps creating such communication between the device and the user will be a nice experiment, but I think beyond engineering work.

Another use case is the fact that the device should be independent of physical sources of electric current. The device should be charged using a solar charger.

The last case of use is to make it resistant to weather conditions that may cause its destruction - e.g. water entering into electrical circuits.

**Conclusions and future work**

I think that creating such a device will be an interesting experience, allowing me to learn a bit about a field that I did not have a chance to learn well in college and develop during my studies. Perhaps it will also be a good idea to develop such a device in a future master's thesis by adding some new solutions to it. At the moment, I am not sure what it could be, but I know that collecting specific weather data on the server will be a good chance, for example, to analyze this data for something for example creating appropriate plots.

Creating this project will require a lot of time for me to make it a real working project. In addition to a well-functioning device, I will also need to correctly study ready-made solutions to know what to follow when creating a project. Such solutions will also be included in the document.