Name: \_\_\_\_\_\_\_\_\_\_ Class: \_\_\_ Date: \_\_\_\_\_\_\_\_

# Solution sheet task 1:

# Weather station

Tasks 1 and 2 turn the sensor station into a local weather station. In the experimental tasks, the weather station is connected to a web server via MQTT that displays the measured data and transmitted images in a dashboard.

## Construction task

See building instructions.

## Programming tasks

Configuring the sensors and actuators:

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Automatisch generierte Beschreibung

**1. Measuring humidity, temperature, and air pressure**

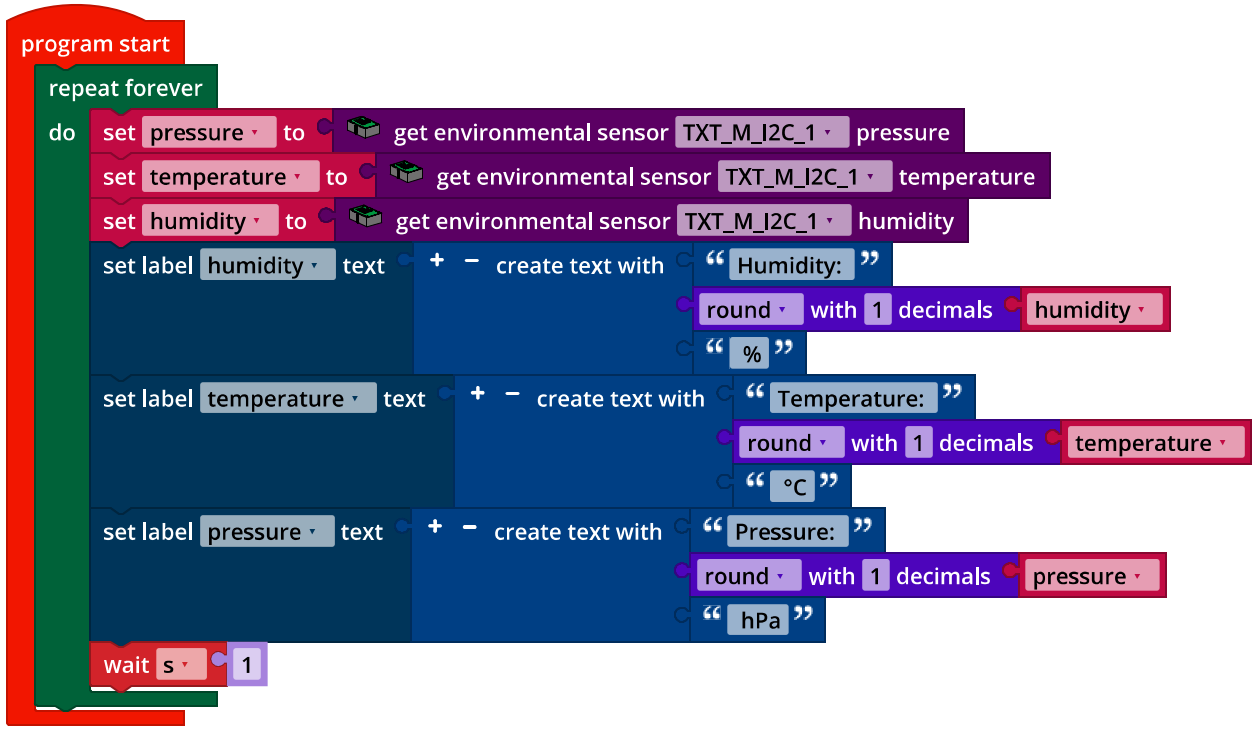
1a. Display configuration (example):

Ein Bild, das Tisch enthält.

Automatisch generierte Beschreibung

Configuring the display output

1b. Program (example):



*IoT\_Meteorological\_Station.ft*

**2. Barometer**

2a. Expanding the display configuration (example):

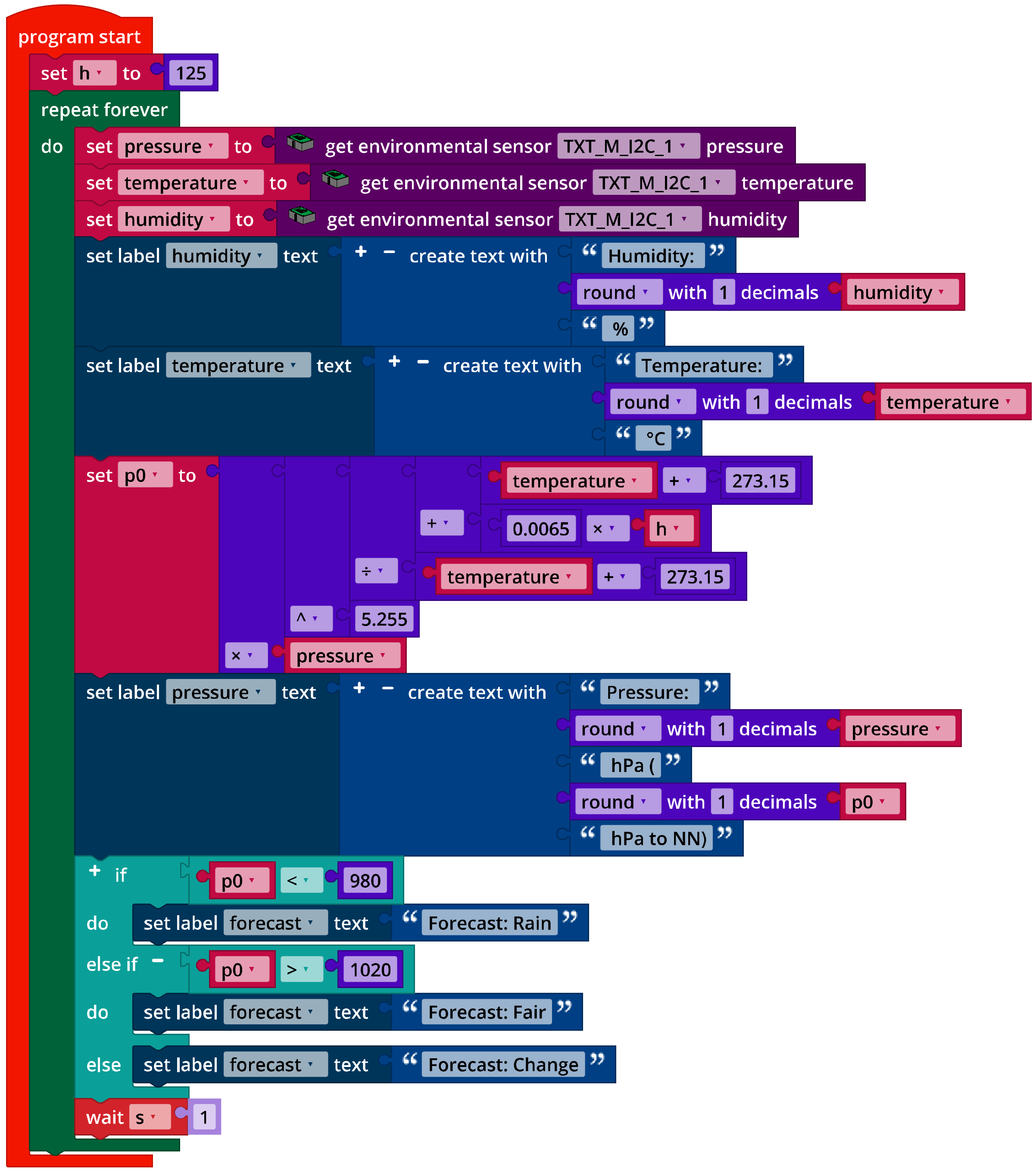
Ein Bild, das Tisch enthält.

Automatisch generierte Beschreibung

Expanding the display output

2b: Program (example):

The temperature values must be converted into Kelvin before the calculation: 0°C = 273.15 K.



*IoT\_Barometer.ft*

## Experimental tasks

**1. Determining temperature using the NTC resistor**

1a. The resistance of the thermistor and the associated measured temperature values for the environmental sensor can easily be determined via a Log output on the console (see example program below).

Three measured values can be used to determine the coefficients a, b, and c of the Steinhart-Hart equation [4, 5] (T: Temperature in Kelvins, R: NTC resistance in Ohms):

|  |  |
| --- | --- |
| Resistance value | Temperature |
| 1500 Ω | 25.0 °C |
| 2362 Ω | 13.7 °C |
| 2530 Ω | 11.8 °C |

Example measurement

The measured values are dependent on the NTC resistance and may deviate.

Coefficients: a = 0.004535418128, b = -0.0003767491105, c = 0.000004023802790

1b. Expanding the display:

Ein Bild, das Tisch enthält.

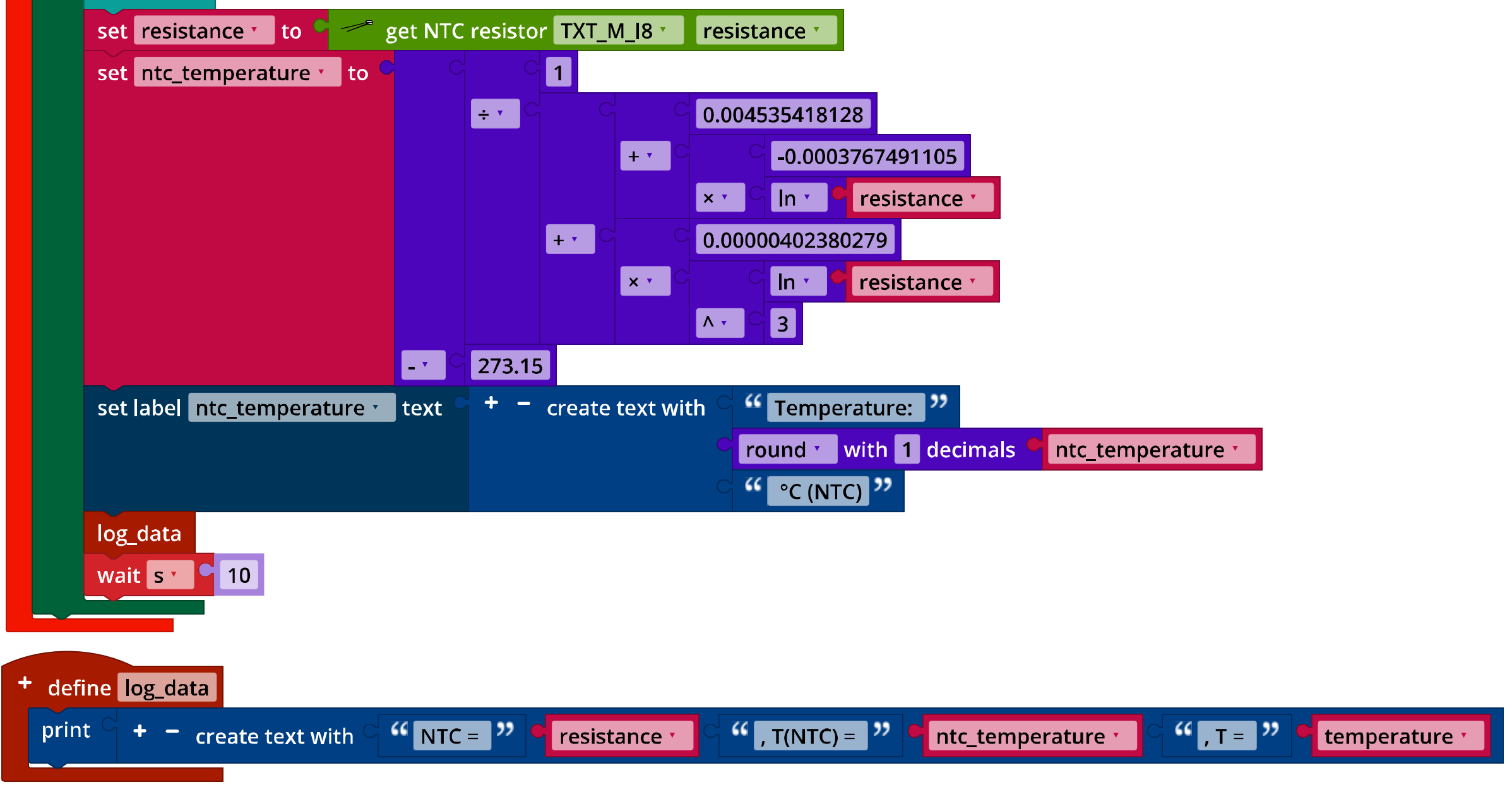
Automatisch generierte Beschreibung

Configuring the display output of NTC temperature measurement

1c. Expanding the program (example):

Calculating the temperature value based on the NTC resistance and output of the measured values for the NTC resistor and temperature sensor on the console.

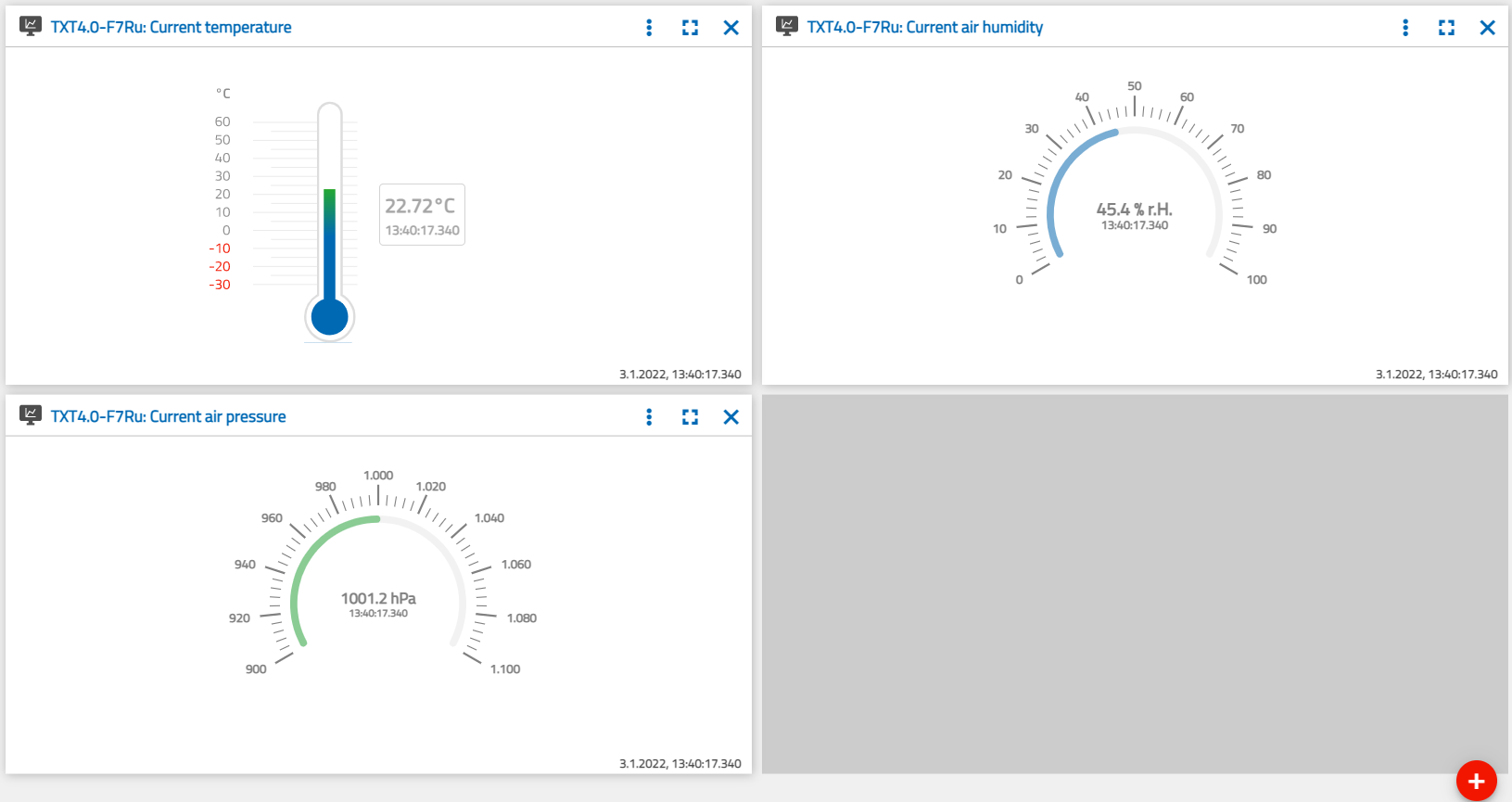
Here as well, the temperature value calculated from the thermistor must then be converted into Kelvins: 0°C = 273.15 K.



*IoT\_Barometer\_with\_NTC\_resistor.ft*

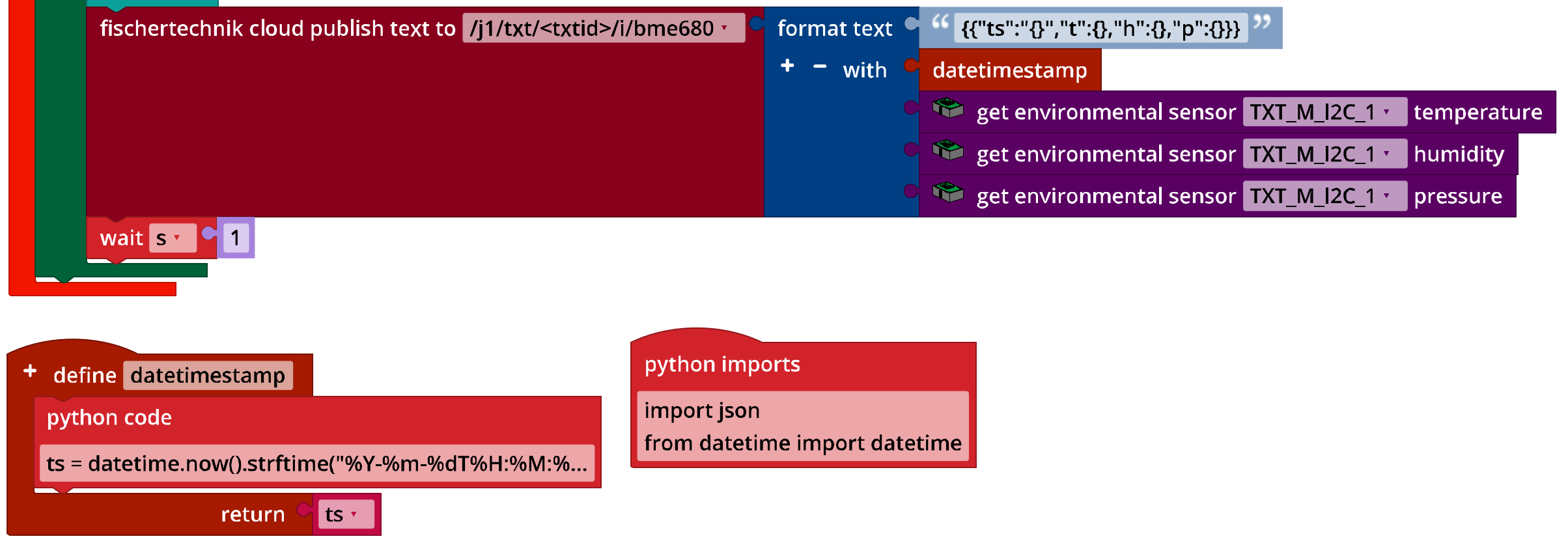
**2. Data visualisation on an IoT server**

2a. Configuring the dashboard on the IoT server in the fischertechnik cloud:



Configuring the display in the dashboard

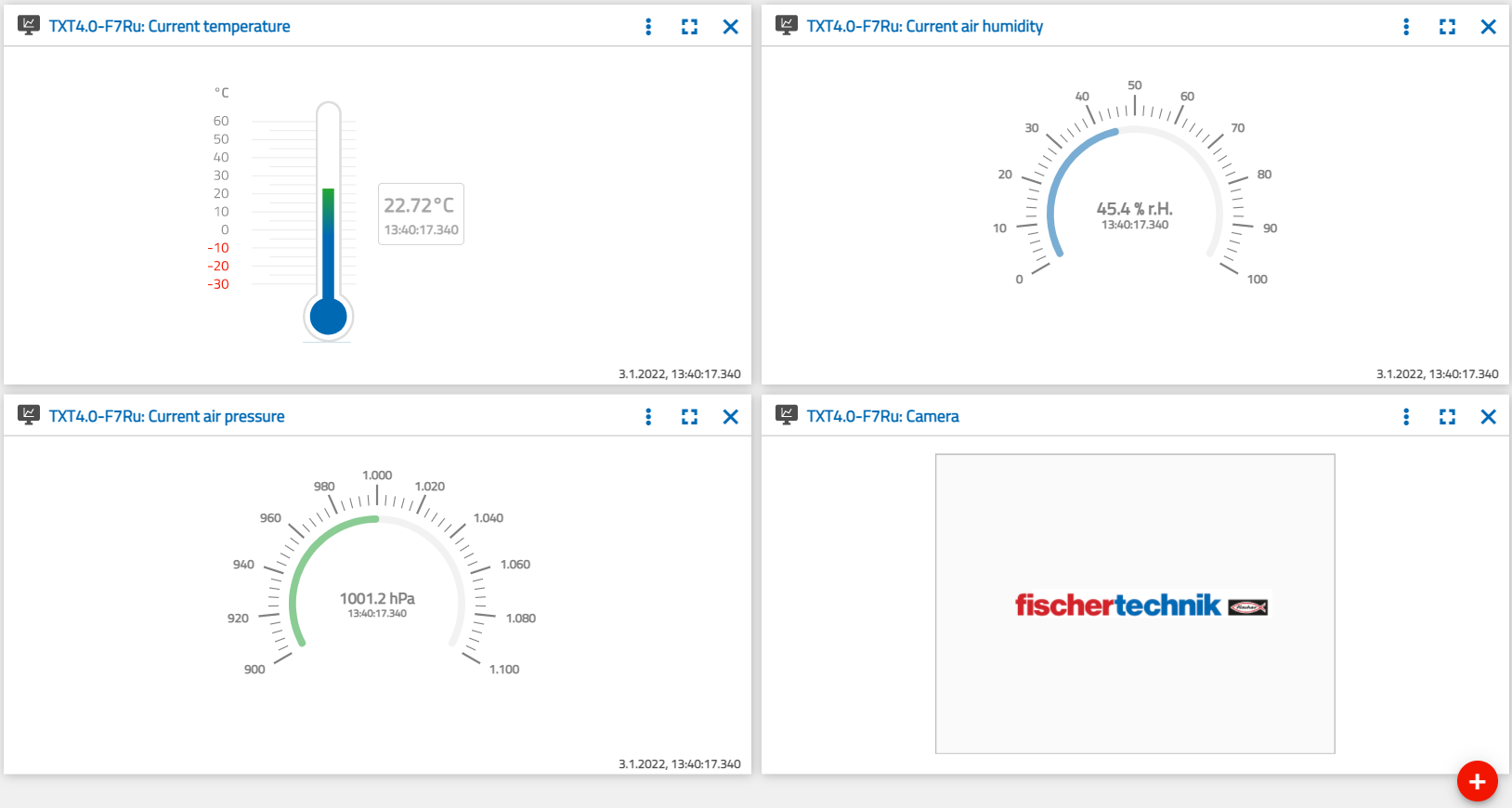
2b. Expanding the program (example):



*IoT\_MQTT\_Barometer.ft*

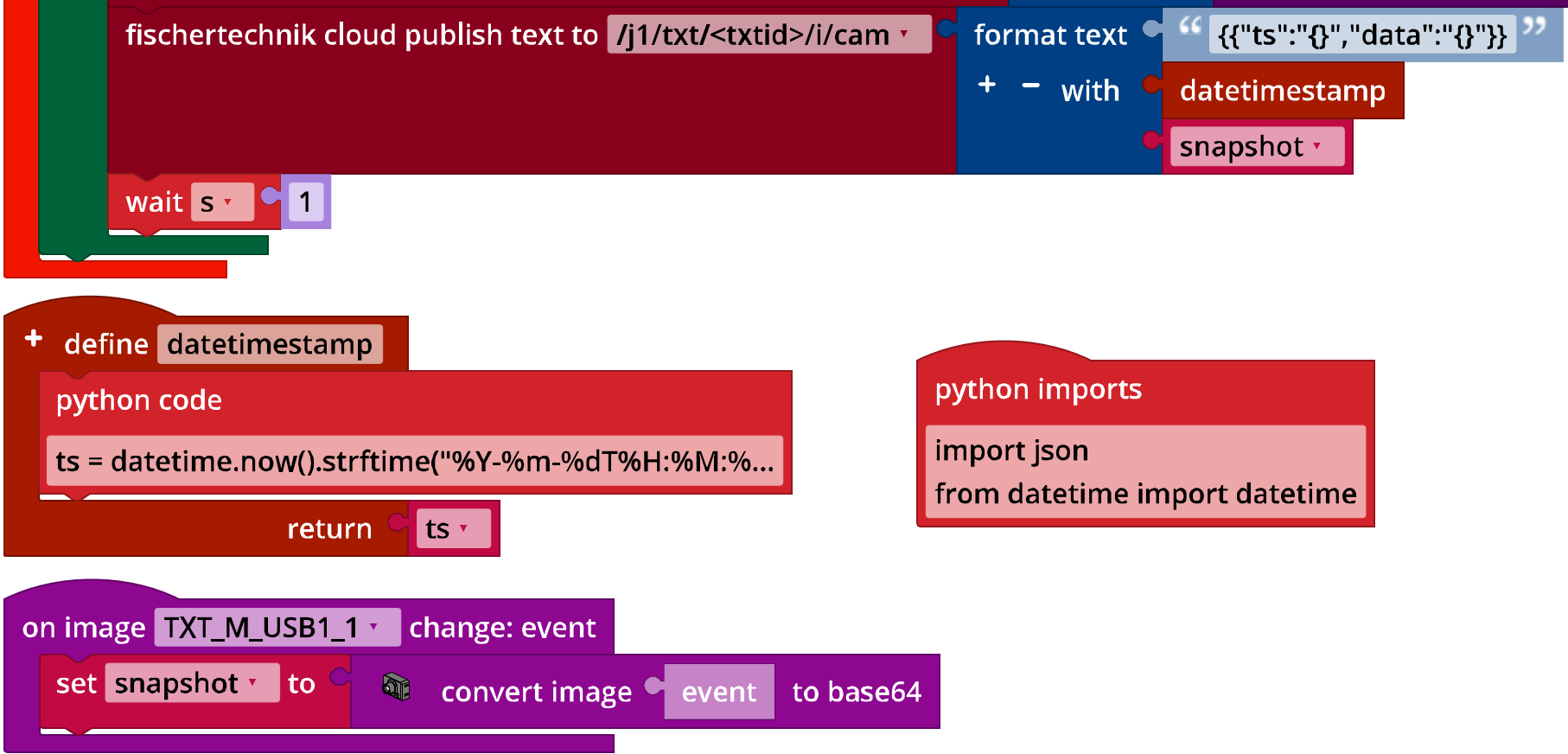
**3. Webcam**

3a. Expanding the dashboard in the fischertechnik cloud:



Dashboard with webcam

3b. Expanding the program (example):



*IoT\_MQTT\_Barometer\_with\_Webcam.ft*

Annex

# Task 1: Weather station

## Required materials

* PC for program development, local or via web interface.
* USB cable or BLE or WiFi connection for transmitting the program to the TXT4.0.
* Example programs “IoT\_MQTT.ft” and “IoT\_Webcam.ft”
* Account in the fischertechnik cloud

## Further information

[1] Wikipedia: [Barometric formula](https://en.wikipedia.org/wiki/Barometric_formula).

[2] Online diagram editor for creating state transition diagrams (drawio format): <https://www.diagrammeditor.de/>

[3] fischertechnik: [*NTC resistance*](https://content.ugfischer.com/cbfiles/fischer/Zulassungen/ft/36437-NTC-resistor.pdf). Data sheet, Art. no. 36437.

[4] Stanford Research Systems (SRS): [*Thermistor Calculator*](https://www.thinksrs.com/downloads/programs/Therm%20Calc/NTCCalibrator/NTCcalculator.htm). V1.1

[5] Dirk Fox: [*“Einmessen” eines digitalen Messgeräts (“Calibrating” a digital measurement device)*](https://ftcommunity.de/ftpedia/2013/2013-1/ftpedia-2013-1.pdf#page=39). ft:pedia 1/2013, p. 39-48.