FULL EXAMPLE

HOW TO MAKE THE INVISIBLE VISIBLE?

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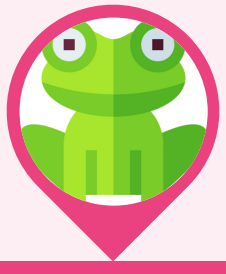


Step 1 - Present the project as a whole

We invite you through this template to get creative while getting technical support in designing a unique and inclusive project! You are free to develop your own solution or to be inspired by solutions proposals. In the end, depending on the path you choose, your solution will be unique!

Describe your project

Name your project: How to make the invisible visible?

Short introduction of what your project is about, the problem tackled behind, the pedagogical objectives

This project consists in developing communicating terrariums for frogs. It aims to raise awareness of climate issues through the discovery of the dendrobatid environment. We propose to monitor the temperature in a terrarium to ensure that ideal conditions (between 21 and 26°C) are present.

Reflect on equity and inclusiveness

ASPIRATIONS & MOTIVATIONS

How do you feel when doing STEM? What motivates you in STEM? What motivates your students? Are all your students motivated by the same? What would they like to do?

- Finding possibilities to apply concretly knowledge and skills into concrete projects
- Creativity as a way to promote inclusiveness
- Provide different oportunites for students' to develop their own relevant projects
- Use of digital technology for fun purposes/playful environments
- Excited about the possibility to create new artefacts

ISSUES AND BARRIERS

What worries your students? What frustrations do they have? Are there any differences that make them be at disadvantage to other students? And regarding robotic and digital in STEM activities?

- Financial resources to access continuous education in technology-enhanced learning topics
- Different objectives according to gender (service vs. fighting)
- Potential difficulties on technological material

KEYWORDS

Indicate 3 or more keywords that describe the reality of your students regarding STEM/STEAM activities.

- NEW
- EXCITING
- SCARY

Step 2 - Collect data thanks to the board and its embedded sensors - 1/2

At this stage, you are required to find a programming solution to collect your data, identify which sensors to be used and how to program them on MakeCode for the platform to communicate with your board.

ORIENTATION

Define what is the problem to be solved, what are data to be collected, what are the learning objectives behind the programming topic?

Context: In order to reproduce the natural environment of frogs and ensure their survival, different parameters of their living environment must be taken into account. What information do we need to know in order to provide them with the most appropriate living environment?

Learning objectives: Identify useful sensors and the procedure to implement them with a programmable board.

CONCEPTUALISATION

Formulate a hypothesis to answer the given problem regarding data collection

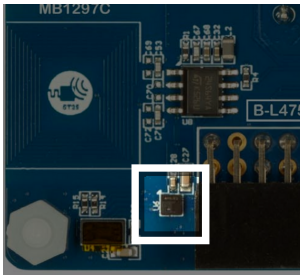
As the main parameter to be controlled to ensure the frog's survival is the **temperature**, and that it must be between **21 and 26 °C**, the solution that seems to be the simplest is to use the **temperature sensor** integrated into the STM32 program card.

INVESTIGATION

Describe the steps you need to collect the data that will be necessary for your project.

This step can be implemented thanks to activity sheet **#R1AS11 - Make a very readable thermometer.** In this activity, we learn how easy it is to read the temperature sensor of the board and display its value.

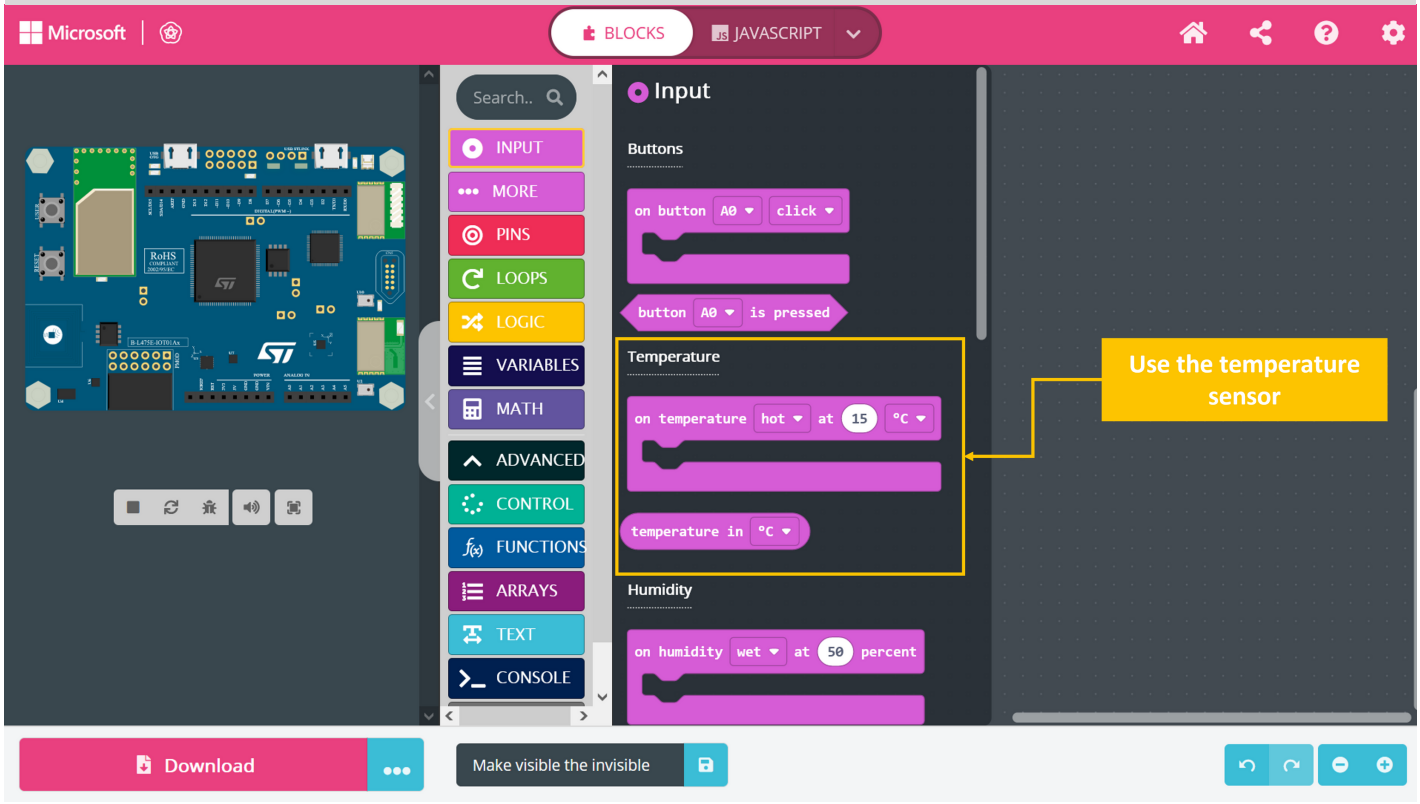
This temperature sensor is located next to the "time of flight" sensor on the right, it is used to implement activities linked to the monitoring of heat or to approaching meteorological concepts. In our case, it will help to monitor the temperature inside the vivarium.



It is possible to ask for the temperature sensor integrated into the board with the block-based programming software available in MakeCode in the "INPUT" blocklist.

Ability to measure temperature
In order to be fully functional, it is necessary that the temperature sensor can operate at least up to 50°C. In order to verify that the sensor will be operational, I looked at the indicator of the temperature of the STM32 board that shows the range measurable by the sensor from -5°C to 50°C. Thus, the choice to use the integrated sensor seems quite satisfactory and sufficient.

Provide screenshots of the MakeCode platform and of your board



DEBRIEF

Identify the knowledge mobilized during this phase, think about your classroom and identify possible learning, add references issues that may come up

Through this step, we were able to define that in order to obtain information about the external environment, a programmable card can use sensors.

For the example of the STM32 card, if we want the program with visual block-based programming software, functions exist to dialogue with its integrated temperature sensor and thus obtain the temperature in degrees Celsius.

A sensor does not have an infinite measuring range, so it is important to check the adequacy between its possible measuring range and the measurements to be made.

Step 3 - Display the data to get the needed information - 1/2

At this stage, you are required to find a programming solution to display your data, enabling, now you have asked a sensor to obtain information, to make this information known to the user.

ORIENTATION

Define what is the challenge in the display of the data you need? For you? For your classroom? For the user?

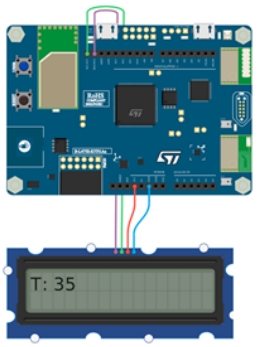
Context: We could see in the previous part how to ask a sensor to obtain information. It would be useful now to be able to make this information known to the user.

Learning objectives: Identify an actuator and control it in order to be able to deliver information

CONCEPTUALISATION

Formulate a hypothesis to answer the given problem regarding data display

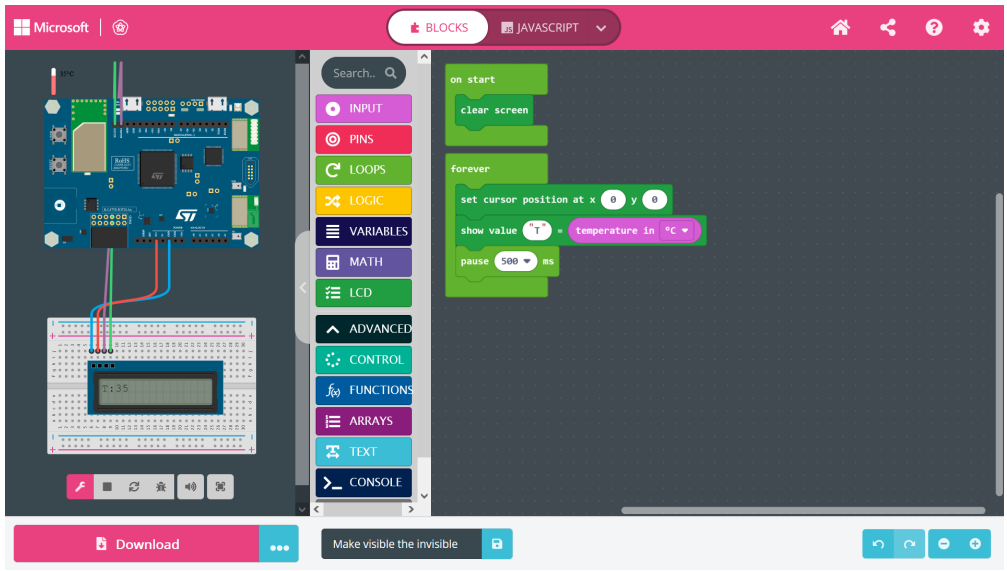
In order to inform the user of the measured temperature, the first solution that comes to mind is to use the **external LCD Text Display**.



INVESTIGATION

Describe the steps you need to collect the data that will be necessary for your project

This step can be implemented thanks to activity sheet **#R1AS10 - Text display with an OLED screen,** a screen helping you to display some pieces of information hidden inside your electronic components. From the documentation of the STM32 card, we can read the functions used for showing the data on LCD display: "**set cursor position at x: y:** " and "**show value** ".



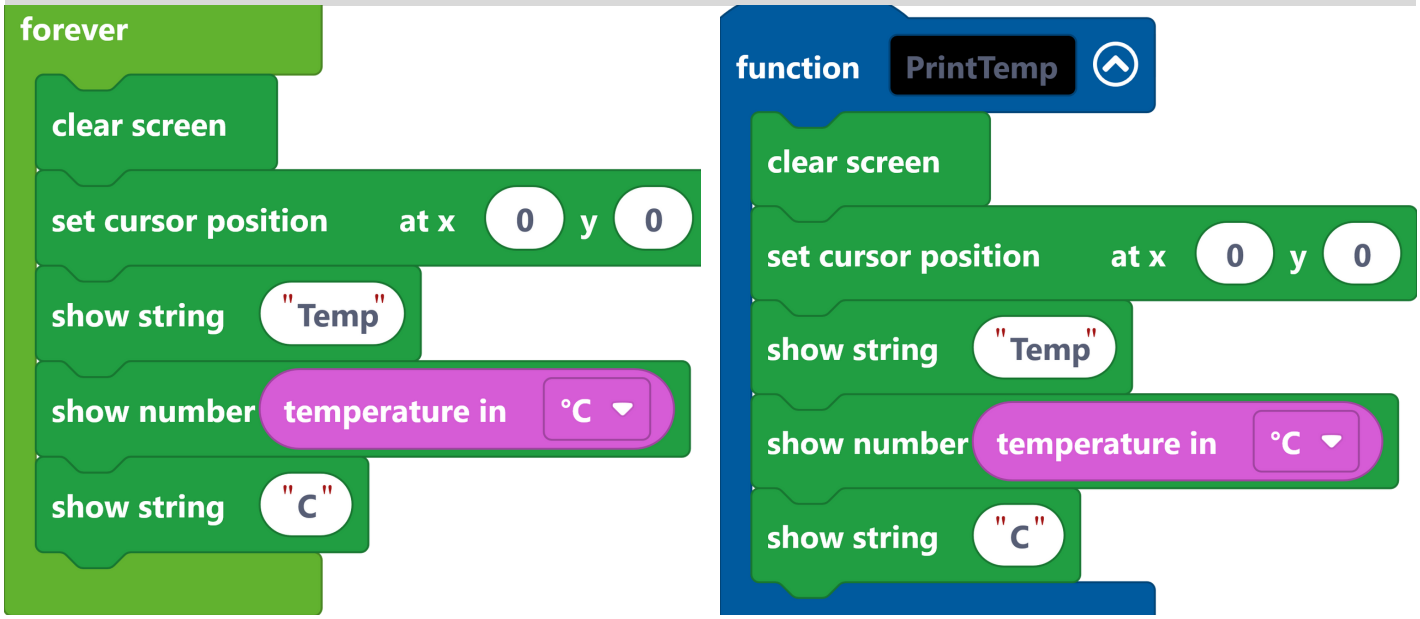
Test program

In order to check if it works, I tested a first program that performs the following task:

- Clean the LCD screen,
- Identify the position of the cursor (on x=0 and y=0),
- Write the word “Temp”, display the value measured by the temperature sensor and write the word “C” (in order to indicate that the temperature is measured in the Celsius scale).

In order to be able to call this program (sequence of blocks) from another program, I replace the loop “forever” with the function block. The function is called “**PrintTemp**”.

Provide screenshots of the MakeCode platform and of your board



DEBRIEF

Identify the knowledge mobilized during this phase, think about your classroom and identify possible learning, add references issues that may come up

Thanks to this step, we were able to connect the LCD screen to the STM32 board.

Note on data types

The data provided but the temperature sensor is an integer and the letter C for the unity is a string, that’s why we used two different blocks:” show number” and “show string”.

In order to structure a program, it is possible to define a function for each task to be performed.

Step 4 - Analyse the data and learn from them - 1/2

Now we are able to display data instantly, we need to analyze them to perform monitoring of our information (for instance, monitoring of temperature, of alerts, motion, frequency ...). This stage is made for enabling this analysis on the editor.

ORIENTATION

Define what is the challenge in this step according to your project. What is your challenge in analysing and extracting the relevant information applied to your context?

Context: We are able to display data instantly. In order to be able to analyze variations in climatic conditions and identify when the temperature level becomes critical for our frogs and the frequency of these alerts, it would be useful to be able to perform this monitoring over a long period of time.

Learning objectives: Analyze data and extract relevant information

CONCEPTUALISATION

Formulate a hypothesis to answer the given problem regarding data analysis

In order to be able to analyze the data from the temperature sensor over a long period of time, I think that using spreadsheet software would be a simple solution. For this, it is necessary to be able to retrieve the data from the programmable board. The solution that I will implement will be to write via the serial port the data in CSV format (comma-separated value) which is exploitable by a spreadsheet program.

INVESTIGATION

Describe the steps you need to analyse and monitor the data that will be necessary for your project

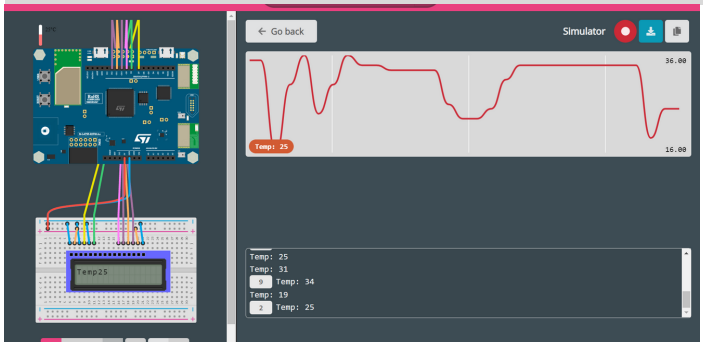
You can use the following resources as a start: https://en.wikipedia.org/wiki/Comma-separated_values. According to the documentation, a CSV file is a simple text document containing data to be presented in table form. The table headings are on the first line, and the data are then inserted line by line. In order to differentiate the data, they are separated by a comma, hence the name of this file format.

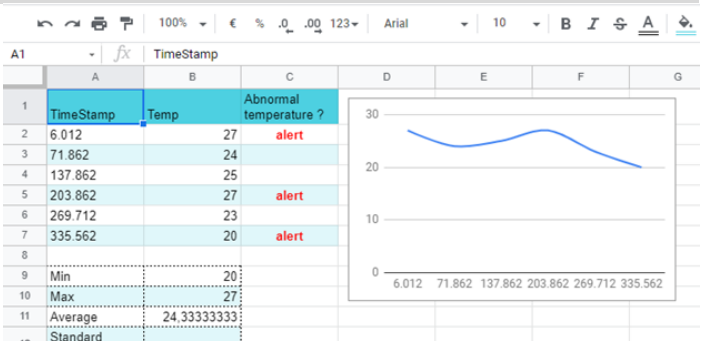
Step 4 - Analyse the data and learn from them - 2/2

Test program

In order to retrieve the data for analysis, I will write to the serial console the temperature provided by the onboard sensor every minute. I'll just have to show the graph and download the data as a CSV file. This document can then be opened with a spreadsheet program. It is thus possible to obtain the mean, minimum, maximum temperature or standard deviation.

Provide screenshots of the MakeCode platform and of your board





DEBRIEF

Identify the knowledge mobilized during this phase, think about your classroom and identify possible learning, add references issues that may come up

Thanks to this step, we were able to discover that a programmable card could also send information via a serial console.

This feature allows to send information faster than using the integrated screen but requires a connected computer.

CSV format

The serial console allowed us to send a text file in CSV format which could then be opened by spreadsheet software to analyze the data.

From this data, a spreadsheet program can easily draw graphical representations or perform statistical calculations.

Step 5 - Use the data to notify the users in case of emergency - 1/3

Now we are able to collect, display and monitor data, we can actually create a solution for using these data in real life for a concrete purpose. This additional step to this project will enable creating a real use case for the whole activity.

ORIENTATION

Define what is the challenge in this step according to your project. What is the concrete objective for the user?

Context: We are now able to measure and analyze the data from the sensors. It would be useful to be able to notify the user about the temperature in the vivarium and in case of detection of the temperature in that it is too high to be able to decrease it.

Learning objectives: Identify a condition and implement a conditional block.

CONCEPTUALISATION

Formulate a hypothesis to answer the given problem regarding this additional step

There are two tasks to perform here:

1. **Notifying the user** about the temperature in the vivarium in the most visible way, for example, by changing the colour of the LCD screen;
2. **Open a window** while the temperature becomes too high.

In order to automatically identify in what temperature range the current state is, and show the corresponding colour of the LCD screen to the user, I will use a conditional "**IF**" block.

INVESTIGATION

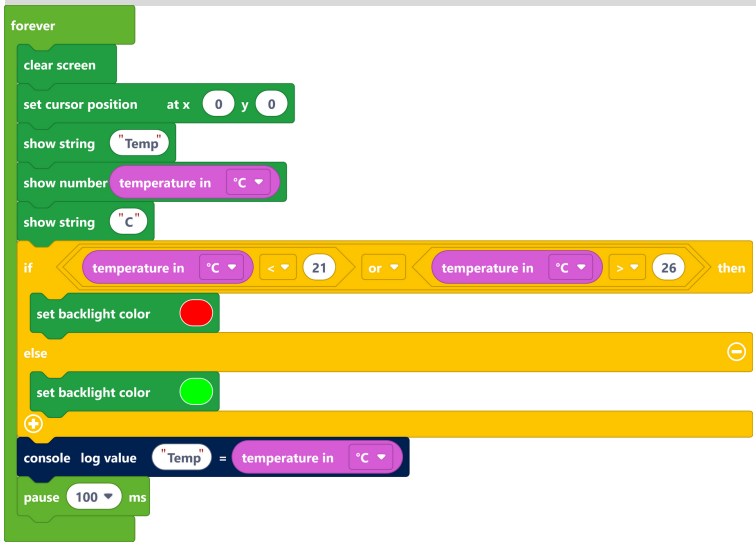
Describe the steps you need at this step in your project

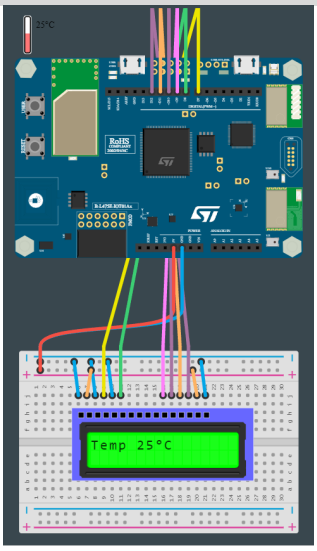
Test program

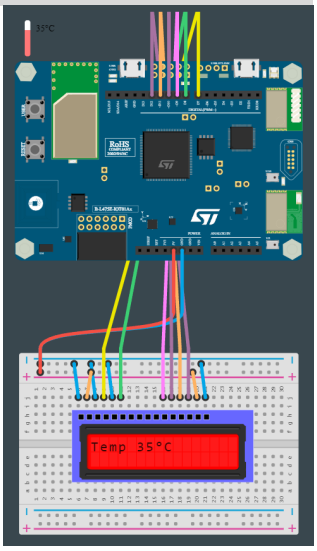
In order to notify the user, the program will change the colour of the LCD screen according to the temperature in the following way:

- **-5..21 C° - red light**
- **21 .. 26 C° - green light**
- **26..50 C° - red light**

Provide screen shots of the MakeCode platform and of your board





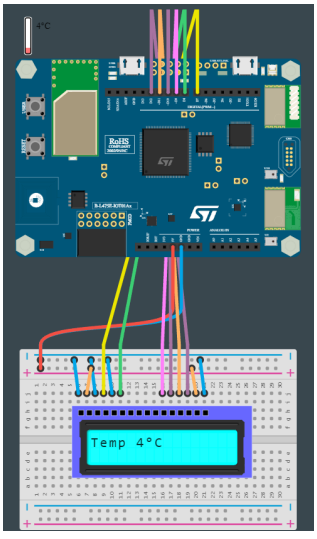


I decided to add one more light in order to notify the user more precisely about the temperature in the vivarium:

- if the temperature is less than 21 C° - turn on the blue light,
- if the temperature is between 21 et 26 C° - green light
- if the temperature is more than 26 C° - red light.

For this, I used the conditional block "**If .. then.. else** ". In each case, I call the function "**PrintTemp**" (that I created at the first stage of my work) to print the current temperature on the LCD screen.

In order to be able to open the window, I connected the stepper motor to the STM32 card. Then I create the function "EmergencyVentilation" that I call in case the temperature is more than 26 C°.



DEBRIEF

Identify the knowledge mobilized during this phase, think about your classroom and identify possible learning, add references issues that may come up

Conditional Loop

Thanks to this step, we were able to discover what a conditional instruction is and its versions: short “if .. then” and long one “if.. then .. else “.

It is an algorithmic structure that will execute an action only if a condition is verified. In our case, an LCD screen with turn on the blue, green or red lights if the temperature is respectively in one of the ranges -5..20, 21..25 or 26..50 C°.

Adding new devices

In order to benefit from new features, it is possible to add extensions providing additional functions.

Here we have added the stepper motor to turn on the ventilation in case the temperature becomes more than 26 C°.