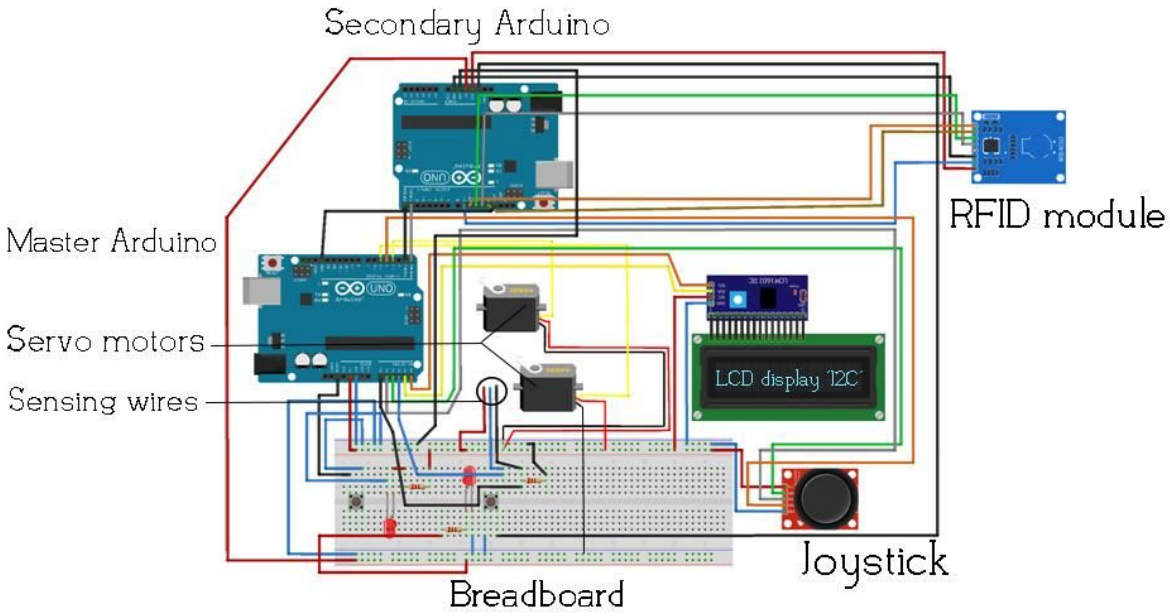
The Science and Technology Creativity Club aims to support and stimulate creativity and innovation linking learning to science; to integrate and use them in our daily lives. It also contributes to the development of the ability of solving day-to-day problems in the environmental field.

WaterX is the project that we decided to create this year.

The project "WaterX" allows the regulation of water consumption, and saves it by recycling water used by the students and rainwater in an intelligent way: it consists of using two microcontrollers (Arduino UNOs) that control the opening and closing of two taps (one placed at the same level as that of the large tank and the other at the level of the small tank) automatically based on the levels of water, its use, the period of the day and the amount of time that the plants were aroused during that night. All of this won't require any human intervention making it a great asset to both public and private gardens.



The rain and tap water will be stored in the big tank, after that the Arduino will send an order to open the upper Servo, causing the water to flow into the small tank. When the latter will be full of water, the Arduino will notice that, thanks to the sensor pin that will read a voltage of 5V instead of the regular ground voltage, when that happens, it will request the upper Servo to close access to the small tank. Then, at midnight or whenever the RFID reader is going to read the serial of the "night tag" the Arduino will request the lower Servo to open and wait until the small tank empties, in that case the Arduino is going to request the enclosure of the lower Servo motor.

NB:

The lower Servo motor will open once in a cycle (Day & Night) and the upper Servo will not follow the automatic cycle if the joystick was moved from its initial place. If we want the servo to follow the automatic code again we need to press the joystick.

This project has gone through multiple phases :

We have started this project (WaterX) on the 20th of September 2018

1- Using the powerful Arduino, we started by including the basics to it ; starting with a water level sensor that was sending information to the analog Pin 0.

2- Then we have included a micro servo motor attaching it to the digital pin 2 (the 5V Pin of the Arduino is enough to power that motor; no power supply was needed), the goal is to open the servo motor (rotate it by 180°) when the water lever data sent through is less than or equals $(20/1024)*(5*1024^{-1})$V and to close it when the water level goes beyond $(900/1024)*(5*1024^{-1})$V

Problem encountered:

The water level sensor sends false info when it is used for the first time (it adds 200 to the value causing servo motor to close earlier)

Solution:

We have solved the problem by adding a 1s30ms delay before closing the motor for the first time

3- For debugging reasons, we have added an external reset button and an LED showing us whether the Arduino is on or not.

4- Now we have to add an LCD display equipped with an I2C backpack to show us some debugging information and the state of the servo motor wiring it to pins A4 & A5 of the Arduino.

5- We are probably going to encounter few more bugs. That's why we have added an emergency system to our project : it consists of an analog joystick that can be moved in any direction to force the Arduino to make the wanted moves (move it to the top : shut the system down – to the left : close the servo motor – to the right : open it back – to the bottom : wake the system up if it is down.)

6- We need to add a second Arduino because most of the analog pins in the first Arduino were used. They are going to communicate

between them via the SPC (Serial Port Communication) and add an external reset button and an LED with a different color to it.

Two weeks later we've met to talk about the progression of the work and what we need to buy. We are going to make the full version of the project and this requires us more material. And then we've talked about another way to replace the water level sensor : We can replace it by two wires .The black wire is the sensing wire,

it is hooked up with a Pull Down resistor; so that if it receives no signal the sensing value will be 0 Volts.

7- Now, because this is only a model we cannot wait until 2:00 AM to see the project working so we are going to add a RFID system, so that we can specify the time ourselves without having to wait.

8- After doing so we have to add the second servo motor (we aren't going to use a stepper motor because it is too slow and requires a lot of power).

9- At this stage the water level sensor was becoming more and more problematic, so we decided to replace it with a total of three wires (one 5 Volts VCC and two analog reading pins).

10- At that point, it was time to work on the software of the project. Starting with choosing a programming language and a compiler:

Giving the fact that we were using an Arduino/A clone we were forced to use the Arduino programming language which is a mix between C++, C, JavaScript and C#, we also decided to stay as close as possible to the C++ language.

We also made the decision to use a compiler called "Microsoft® Visual Studio Community" as it is the most developed IDE that can use the Visual Micro Plugin and because it is free.

11- It was time to write the code itself. First off, we had to create some classes to simplify the task of coding the microcontrollers.

12- Then we had to implement the libraries that the different modules will use.

13- Next, we went to the body of the coding.

Everything went well afterwards, except for one thing: We didn't have enough money / resources to achieve a decent model.

All in all, WaterX was a great experience and a great project to be part of. It's a project that brought students who had the passion of technology and science together, helped discovering new talents and potentially future geniuses who, otherwise, could've went unnoticed and their knowhow wasted.