Final Exam Presentation

IoT and Big Data

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Automatic plant watering

01

Description

Over the last decade, we have experienced a growth of IoT devices, especially in the fields of home automation, health and agriculture. Regarding the latter field, the use of IoT devices has been very useful in defining energy and water savings that can contribute to improving the tragic climate situation we find ourselves in.
My first project was realized virtually by mean of *Tinkercad.com* platform: this is an **automatic irrigation system** that allows the use of water to be regulated by sensors to meet the needs of a single plant (whether it is in a pot, indoors or inside a greenhouse).
In order to detect the correct amount of water relative to different weather conditions, a multiple linear regression function was assumed:

Water need = - 0.5 * soil moisture – 0.3 * temperature + 0.1 * luminosity

- The **photoresistor** collect the amount of light makes it possible to detect the ambient light level in order to identify the various hours of the day and evening,
- The **temperature sensor (TMP36)** makes it possible to detect the degrees centigrade of the atmosphere and helps to identify the various seasons,
- The **soil moisture sensor** makes it possible to measure the amount of water absorbed by the soil,
- The **LCD display** shows respectively, by pressing and releasing the button, the water consumed in liters per hour and the total cost (€/h),
- A **DC motor**, representing the water pump, is automatically powered and runs several revolutions per minute depending on the amount of water the tap needs to deliver,
- An **orange LED** lighting the same intensity as that of the DC motor.

Throw the serial monitor is possible to check the liters of water per hour that the tap is dispensing at that moment and, by pressing and releasing the button, the **cost of water**, considering the real price of water, which amounts to *1.37€ per cubic meter*.

Finally, it should be specified that the optimal watering conditions have been considered in a general way: *in mild weather and during twilight hours with a dry soil level, the pump will be at its maximum flow rate*. After that, the soil moisture sensor will begin to detect less and less moisture until the pump detects an optimal moisture level (approx. 40%) and then automatically switches off.

Circuit Diagram

Photoresistor is a type of light sensor whose resistance varies inversely with the intensity of light: the conductivity increases by increasing light intensity

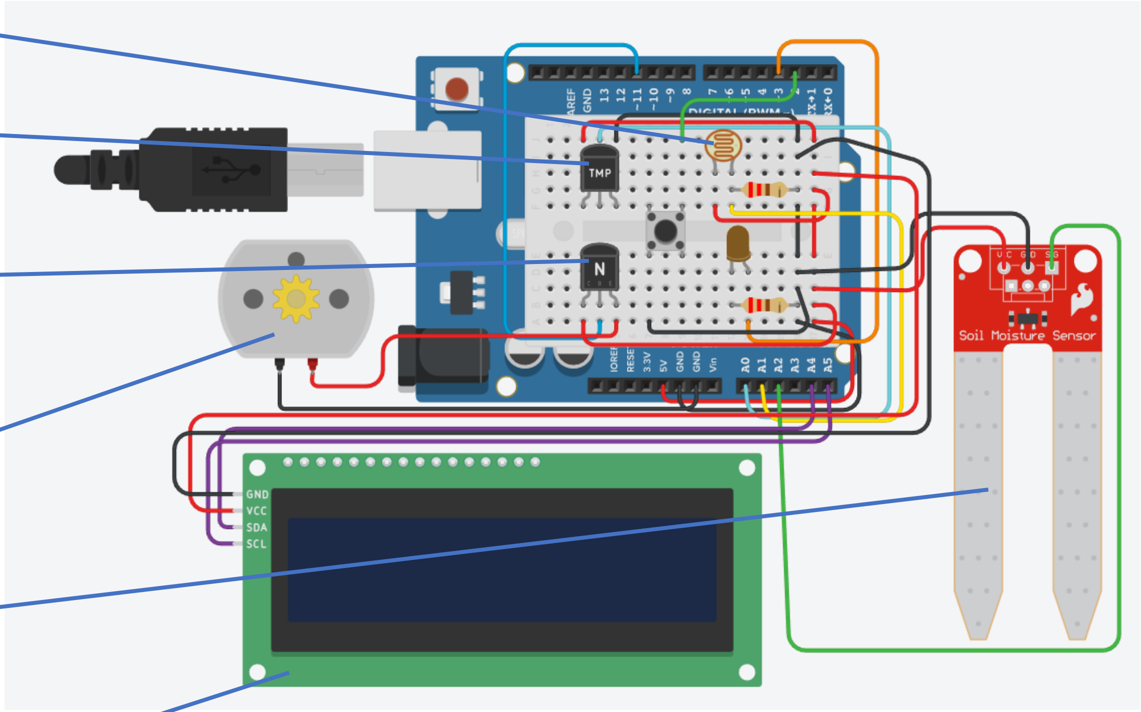
TMP36 is a type of analogic temperature sensor that send to the board a voltage directly proportional to the detected temperature

The **bipolar junction transistor** works as a switch and current amplifier for the DC Motor. It’s a common base transistor composed by three semiconductors: the pin connected to the base activates the transistor, which “collects” the current and “emits” it to the motor.

The **Direct Current Motor** receives the current from the transistor and transforms it into mechanical / rotary clockwise movement with a Revolution Per Minute which is proportional to the power which it receives.

The **Soil Moisture Sensor** measures soil moisture grace to the changes in electrical conductivity of the earth. The electrical resistance is measured between the two electrodes of the sensor. A comparator activates a digital output when an adjustable threshold is exceeded.

The **Liquid Crystal Display** communicates with the board thanks to a I2C protocol which uses the SDA signal that takes care of transmitting and sending data, and SCL that send clock signals repeatedly to synchronized the communication



Further Developements

When considering the possibility of *drawing from a well or rainwater harvesting system*, the values displayed on the LCD will refer to **the amount of water and money saved**.

The integrated LCD that allows to monitor the consumption (or savings) can be substituted with the possibility to check values on a smartphone throw a **network connection**.

The application of **machine learning algorithms** by collecting data from sensors can lead to important results like controlling water waste, optimizing the irrigation function or predicting the health status of plants

Virtual Pet 2.0

02

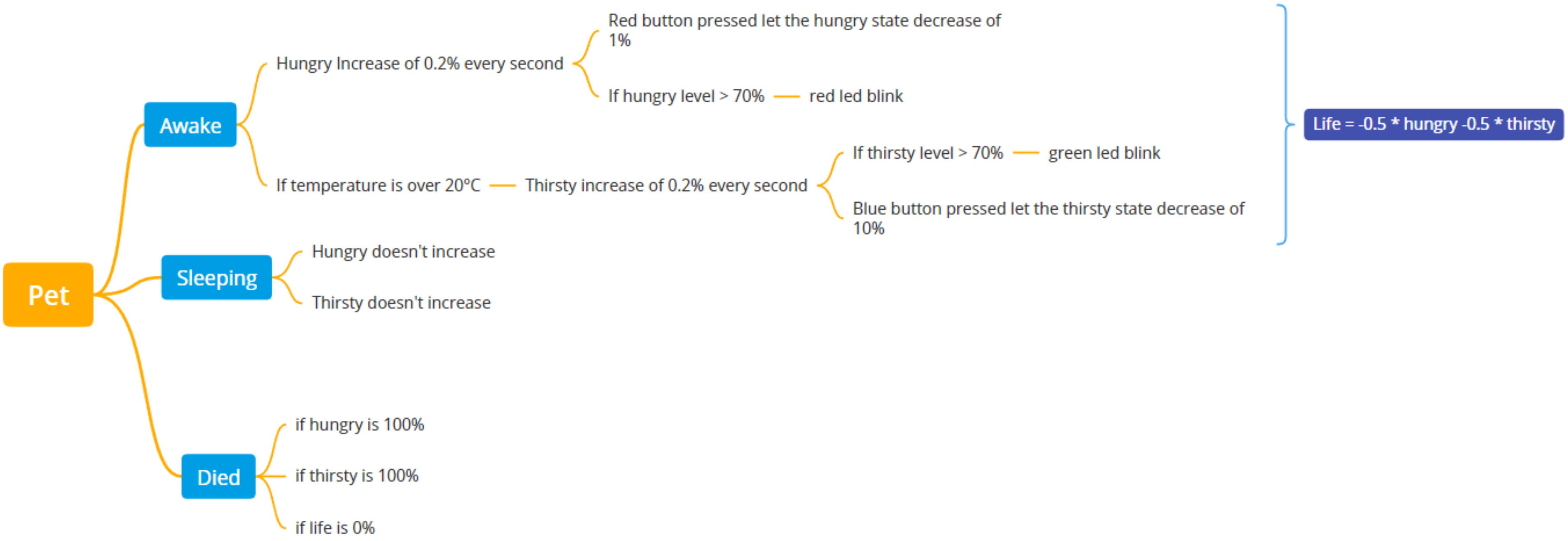
Description

The virtual pet was one of the first technological advancements that became popular among children's games. One of the most famous examples is the **Tamagotchi**, a small electronic egg with a screen on which one could choose and visualize the life of a pet of one's choice. However, early editions of these game did not represent an IoT system, and the latest updated edition does not include the use of sensors or connections.
Wanting to recall one of the fondest memories of my childhood, I decided to implement an IoT version of a virtual pet.
My second project therefore involves the material realization of a circuit using a **Wemos D1 R1 board** that uses the *ESP8266* microchip capable of connecting to a Wi-Fi network.
In addition, two types of sensors were used to allow the virtual pet to behave as truthfully as possible:

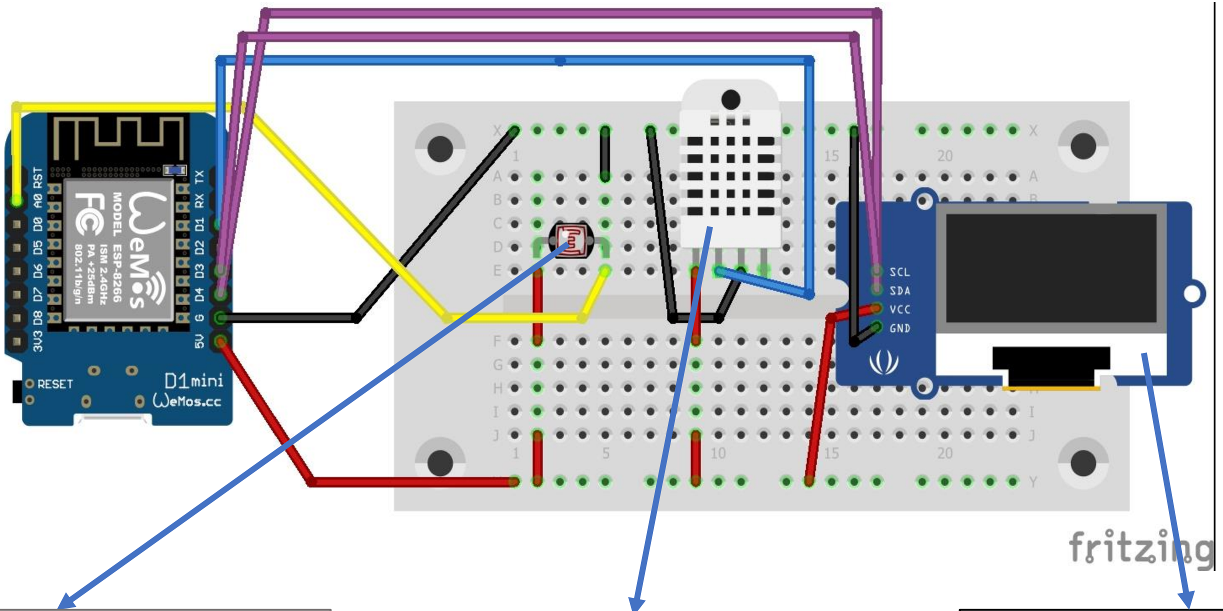
- the **photoresistor** allows the virtual pet's waking up and sleeping state to be reconciled with the real day and night hours and to increase the feeling of hunger during waking,
- the **temperature sensor** allows the virtual pet to detect a temperature high enough to increase the feeling of thirst.

The main development concerns the possibility of controlling the virtual pet from a smartphone using the **Blynk platform**, a cloud platform that allows virtual pins to connect to the board and control the virtual pet from anywhere in the world.

Diagram Flux



Circuit Diagram



Photoresistor is a type of light sensor whose resistance varies inversely with the intensity of light: the conductivity increases by increasing light intensity

DHT11 is a type of temperature sensor that measures temperature and humidity of a certain room. Here, temperature only has been used

OLED display which communicate with the board throw clock and data: the SDA pin allows to exchange the data with the board and the SCL pin to exchange “ping”

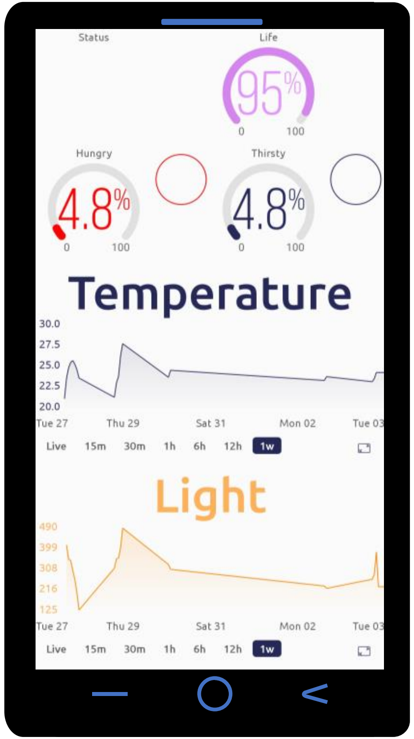
Blynk Server connections

Thanks to the Wi-Fi connection integrated into the ESP8266, the board can connect to the Blynk server, which display values throw the usage of Virtual Pins.

The scope is to replicate the connection showed in the circuit diagram into a virtual space. The server makes use of ten virtual pins:

- **V0** is connected to a gauge widget showing the life status
- **V1** is connected to a button widget and write the red button status
- **V2** is connected to a gauge widget and read the hungry percentage
- **V3** is connected to a red led that blink if the pet is starving
- **V4** is connected to a gauge widget that read the thirsty percentage
- **V5** is connected to a button widget and write the blue button status
- **V6** is connected to a blue led that blink according to the thirsty status of the pet
- **V7** is both connected to a chart and a label widget and read the luminosity throw the photoresistor
- **V8** is both connected to a chart and a label widget and read the Celsius degree throw the temperature sensor
- **V9** is connected to a yellow led and read the status of the pet according to the luminosity threshold

Dashboards' responsive visuals



For this purpose, the **time interval** related to increasing or decreasing percentages are very short in order to allow the visualization of each features in a short range of time. However, for a real-life project, a development of the timing interval is strictly necessary in order to extend the life of the pet during different days, instead of seconds.

It will be interesting to extend the features by adding some **other details** and characteristics, such as cleaning the pet according to some actions or increasing the pet humor by playing games.

It could be possible to insert the **Bluetooth connection** option in addition to the WiFi option, to enlarge the batterey power life.

By using different kind of boards, it’s possible to save power consumption and add some other status related to the Heartbeat detection, like the happyness of the pet with a **Pulse sensor**.

Further Developements

THANK YOU