Aquarium Management

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1 Introduction

Taking care of an aquarium is a hard task when it comes to responsibility and amount of work. In order to keep fish alive, it is necessary to manage the aquarium's environment properly, i.e. according to the fish's living conditions, specially regarding the characteristics of the water - type (salted or fresh), temperature and PH - as well as the light conditions - darker or lighter.

People need to measure manually those parameters very often to make sure that the fish's living conditions are being satisfied. So, it is useful to have a mechanism that gives some sort of alert when those conditions are not being respected, e.g. if the water's PH is not within the appropriate range for the fish, then the user could be notified with that information, instead of manually measuring it consistently.

In the context of the course of Mobile and Pervasive Computing Systems, we aim to develop a system that not only shares the real-time conditions of aquariums with people, but also allows them to set, in real-time, some of the aquariums' characteristics either locally (same network) or remotely (different networks).

2 Architecture

This project consists of the design and implementation of three components, as shown in Figure 1: a physical simulator, a mobile application and a server.

The physical simulator senses and controls the various hardware components, which are accessible and controllable via a single-board micro-controller like an Arduino or ESP32.

The mobile application is the main way of interaction with the user, allowing him to access and modify some characteristics, and define some alerts for each of the aquariums.

For persistently storing every measured characteristic from each aquarium, there is a server which is able to store and retrieve that information. Both the physical simulator and the mobile application can communicate directly with each other and with the back-end server. The physical simulator needs to inform,

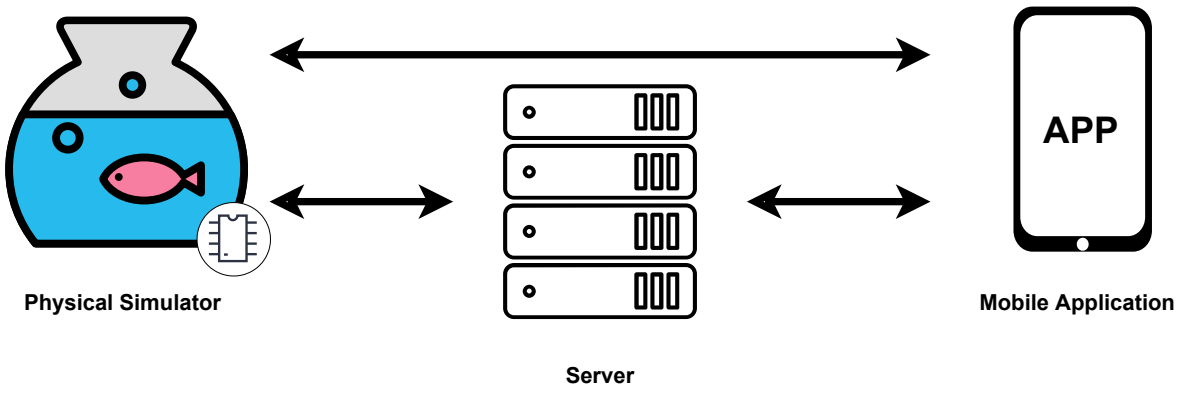

Figure 1: Architecture

periodically, the back-end server with the measured values so that the real-time state of the aquarium can be stored, as well as to obtain the remote updates from the back-end server. Also, the mobile application needs to get the real-time conditions of the aquarium, periodically, from the server to display them. However, if both of them happen to be in the same network, than they can communicate directly with each other, but the final state of the physical simulator must be stored in the back-end server.

3 Physical Simulator

The physical simulator consists of assembling some hardware components:

- Sensors: *2 Potentiometers* and *1 Photoresistor*
  - 1 Potentiometer: for simulating the PH level
  - 1 Potentiometer: for simulating the temperature level
  - 1 Photoresistor: for measuring the ambient light
- Actuators: *4 White LEDs*, *1 Blue LED* and *1 Green LED*
  - 4 White LEDs: for simulating the internal light with multiple intensities
  - 1 Blue LED: for warning the user that the PH level is not within the correct range
  - 1 Green LED: for warning the user that the temperature level is not within the correct range

4 Mobile Application

The mobile application is composed by three main screens, which are illustrated in Figure 2:

- Aquariums List: displays a list with the aquariums' names;
- Aquarium Details: displays the environment conditions of the chosen aquarium: temperature, PH and illumination levels. The user can also choose between manually setting the illumination, or letting the system to manage it automatically;
- Aquarium Settings: allows the user to specify the range of values that are allowed for the temperature and PH levels.

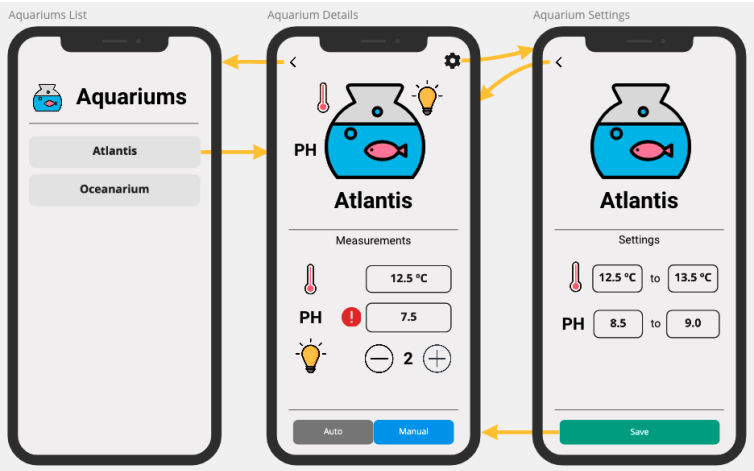

Figure 2: Mobile Application

When the users open the application, they observe the Aquariums List screen, where they choose the aquarium they intend to keep up with.

After selecting an aquarium, they are redirected to the Aquarium Details screen that allows them to observe the environment characteristics of the aquarium selected, as well as controlling the brightness, or simply having it automatic (according to what the photoresistor sensor is capturing).

Finally, when the users tap on the settings button of the aquarium, they can configure the range of values allowed for the temperature and the PH levels of the water.

If the value of any of these parameters (temperature and PH levels) happens to be outside of the specified range, then an alert on the Aquarium Details screen is shown, e.g in Figure 2, we can observe that the measured value for the PH is outside of the defined range of values, so a "danger" icon is shown in the PH measurement section, and the same could happen for the temperature. These alerts would also be present in the physical simulator, where if the blue LED is flashing, it means the PH level is out of the appropriate range of values, and the same would happen for the green LED if that was the case for the temperature.