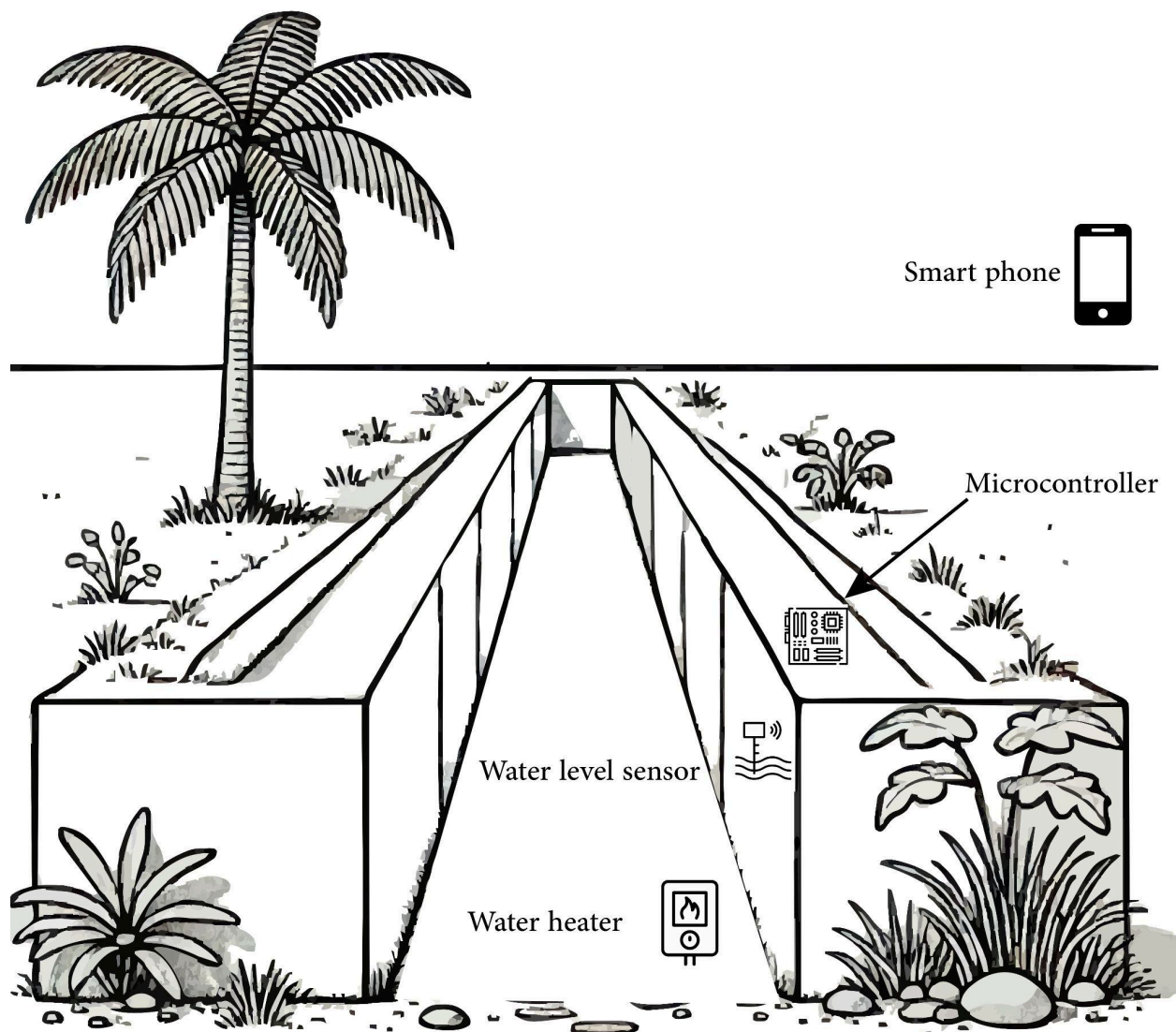


Exercise: 15 pts

Farmers address excess water in agricultural fields by creating ditches to collect it. The water is then transferred from one ditch to another until it eventually reaches a canal, such as the Oued Khrouf Canal. However, we need to remove the water when we do not have a canal.

Propose an IoT solution to remove excess water from the ditch. The solution should be monitored by smartphone.

1- Add the list of things, microcontrollers, and any device with the name in the following drawing (2 pts).



List of Things, sensors, and actuators:

1- Microcontroller.

2- Smartphone.

3- Water level sensor.

4- Water heater.

2- General behavior (2 pts):

- The microcontroller evaporates the water when the ditch is not empty.
- The user monitors the water level and the heating from the smartphone.

3- Specific Behavior of Each Thing (4 pts):

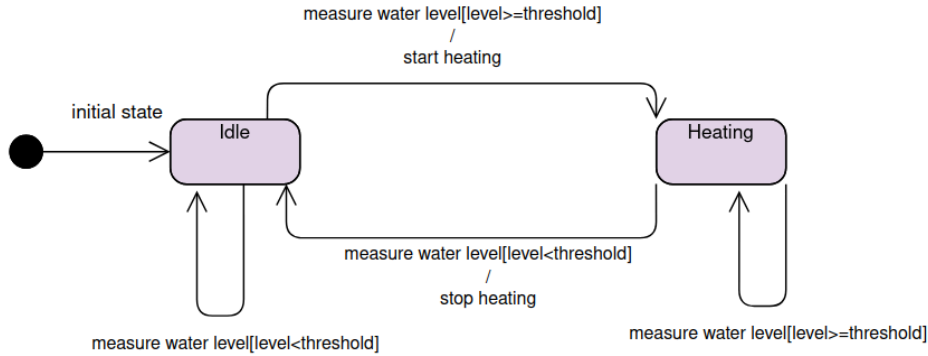
- Thing (**3 pts**):
 - Behavior: The water level sensor monitors the water level.
 - Once the level reaches an acceptable level, the microcontroller signals the water heater, initiating the heating process.
 - Once the level reaches a minimum level, the microcontroller signals the water heater to stop.
 - Microcontroller: Arduino/ESP32/Raspberry pi/etc.
 - Sensor: Water level sensor.
 - Actuator: Water heater.
- Smartphone (**1 pts**): contains a mobile application that monitors the water level and the heating process.

4- Connectivity and Protocols (2 pts):

- Internet communication between the smartphone and the microcontroller.
- MQTT protocol for lightweight messaging.

5- State machine diagram (5 pts):

Model the system behavior using the state machine diagram, do not consider the smartphone.



Exercise 2 (5 pts):

What are the types of MQTT protocols based on the quality of service? (2 pts)

- QoS 0: At most once (fire and forget).
- QoS 1: At least once.
- QoS 2: Exactly once.

Draw a sequence diagram for the most reliable protocol. (3 pts)

