Project Title : # Smart Water Fountains

Phase – 3 : Development Part – 1

In this part you will begin building your project.

Start building the IoT-enabled Smart Water Fountains system.

Deploy IoT sensors (e.g., flow rate sensors, pressure sensors) in public water fountains to monitor water flow and detect malfunctions.

Develop a Python script on the IoT sensors to send real-time water fountain status data to the platform.

1. Introduction

1.1 Objective:

Today, more people around the world have pets than ever before. According to American Pet Products Association's survey in 2020, 67% of U.S. households own a pet which is about 84.9 million homes. This proportion has been increased by 20% in thirty years [1]. Breakdown of the pet types, cats and dogs are the most popular animals, they contribute to about 80% of all pets. Same trend happens all over the world. On average, one in three households own a dog globally and about a quarter of households worldwide own a cat [2]. Both cats and dogs prefer flowing water. A source of fresh clean running water can encourage pets to drink. Drinking a certain amount of water daily plays an important role in long-term health for pets, especially cats. As a result, a water fountain is essential to most households having cats or dogs as pets. However, we can not ensure the water quality when we are away from home for several days. It can happen when pets have finished all remaining water in the water fountain, or water has been polluted somehow by the pet. These can cause the pet to be unwilling to drink water from the fountain. Our goal is to design a smart water fountain that can monitor the water quality and automatically replace water when polluted(not healthy) or running out. We will use sensors to measure the water quality. Common water quality measurement factors include temperature, Ph-value, conductance, turbidity and hardness [3]. Considering the pollution at home can only affect limited factors, we choose temperature, Ph-value and conductance to be the three properties used for calculating water quality in our water fountain. These data will be collected, calculated, and reflected to the user in terms of "Good", "Average" and "Bad". The water fountain is also designed to self-filter the water every time when water is pumped through the submersible water pump.

1.2 Background:

There have been quite a lot of water fountain products on the market[4], while most of them have only filtration as an extra function besides providing running water. [5] The

size of the water fountain limits the capacity of the water source that most water fountains cannot store enough water for multiple pets to drink in several days. Our water fountain can be connected to an extra water source that provides enough water for long-term usage. The link is adaptable to universal water bottles for convenience. The sufficient water source as well as automatic replacing and refilling function enable pet owners to leave home for several days without worrying about water supply for pets.

1.3 Physical Design:

A pictorial representation of your project that puts your solution in context. Not necessarily restricted to your design. Include other external systems relevant to your project (e.g. if your solution connects to a phone via Bluetooth, draw a dotted line between your device and the phone). Note that this is not a block diagram and should explain how the solution is used, not a breakdown of inner components. Figure 1 Smart Fountain Physical Diagram

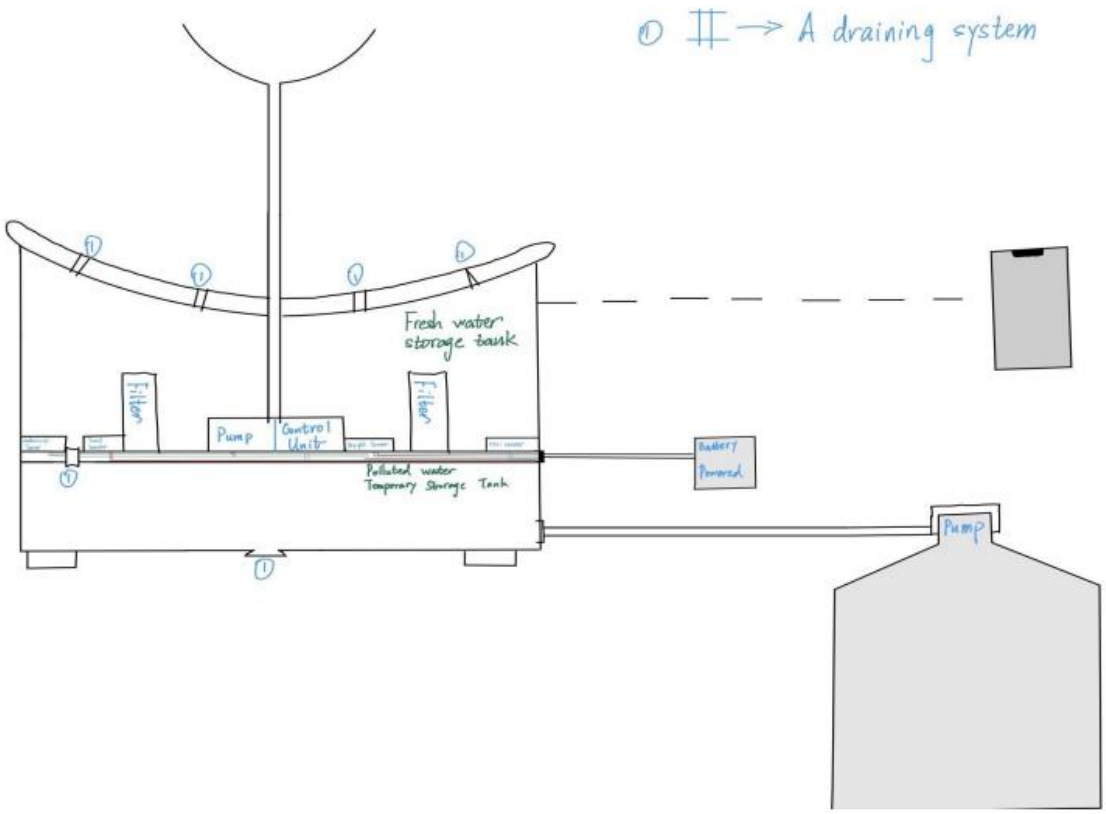

Figure 1 Smart Fountain Physical Diagram

1.4 High-level requirements list:

• Able to drain the polluted water and replace it with fresh water. Specifically, the polluted water will be drained by a motor-controlled valve to the “polluted water temporary storage tank” part. After completing the draining process, fresh water will be pumped from the general water supply(as described in the right down corner of the physical design, Figure 1).

• The fountain must accurately monitor the water quality, including measuring water temperature up to 48.89C and pH values between 6.5 and 8.5.

• Able to be connected to the users’ devices through WIFI. Prompt feedback from the smart water fountain to users’ interface with relevant information including the remaining water level and water quality index: ‘Good’, ‘Average’ and ‘Poor’.

2. Design:

The block diagram below is a general design of our solution. We divide our design into four modules, including Power Supply, Control Unit, External Control, and Mechanical Unit. Details of each unit is presented in the diagram and described in the next section.

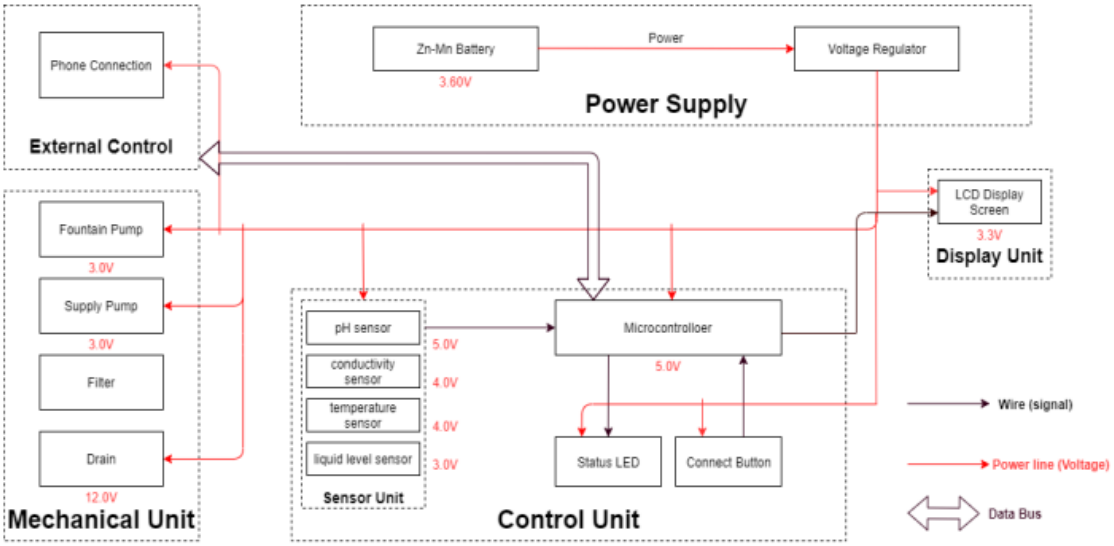

Figure 2 Block Diagram of Smart Water Fountain

2.1 Sensor Unit

This block contains the four sensors. The data acquired from the sensors will be transmitted to the control unit. Control unit will then have some logic designed to send corresponding signals to control other blocks of the water fountain. At the same time, the display screen on the water fountain will display the readings along with the determined water quality level and remaining water quantity. For the PH-value sensor, temperature sensor and conductivity sensor, values will be retrieved and calculated to

determine the overall water quality level. When poor water quality is determined, the water replacement procedures will take place. The weight sensor readings will be used to determine the amount of fresh water left in the water tank.

2.1.1 Temperature Sensor:

A water-proof temperature sensor is going to be used. Part number from sparkfun is: DS18B20 [6]. This temperature sensor is compatible with a relatively wide range of power supply from 3.0V to 5.5V. The measured temperature ranges from -55 to +125 celsius degrees. Between -10 to + 85 degrees, the accuracy is up to +-0.5 degrees. This sensor can fulfill all requirements needed for this project.

2.1.2 PH-sensor:

PH value is a valued indicator of water quality. This PH-sensor[7] works with 5V voltage, which is also compatible with the temperature sensor. It can 6measure the PH value from 0 to 14 with an accuracy of +- 0.1 at the temperature of 25 degrees.

2.1.3 Conductivity sensor:

Conductivity sensor is also part of the water quality assessment. The input voltage is from 3.0 to 5.0V. The error is small, +-5%F.S. The measurement value ranges from 0 to 20 ms/cm which is enough for water quality monitoring. [8]

2.1.4 Liquid Level Sensor:

This sensor [9] is responsible for reflecting how much freshwater is left in the water tank. When the water level is low, fresh water will be pumped to the water tank to ensure the water fountain keeps running with freshwater. This sensor is 0.5 Watts. For water level from 0 to 9 inches, the corresponding sensor outputs readings from 0 to 1.6. From that, the quantity of freshwater left can be determined.

Conclusion :

In conclusion, smart water fountains represent a promising innovation in the realm of public and environmental sustainability. These devices offer numerous benefits, including efficient water conservation, enhanced user experience through features like touchless operation and water quality monitoring, and the potential to reduce plastic waste from bottled water. As technology continues to advance, we can expect smart water fountains to play a more significant role in promoting eco-friendly practices and improving access to clean drinking water in public spaces. Their adoption is not only a step towards a more sustainable future but also a testament to the power of innovation in addressing critical global challenges.