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Real-world Design and Application of Microcontroller Unit in IoT Smart Vase

Introduction

The design of a smart vase with the use of embedded system usually consists of several topics, including the waterproof embedded device, power technology for low-power embedded devices, the IoT & database communication with embedded devices, and PCB design. This technical review paper will focus on the IoT & database communication with embedded devices. Raspberry pi 4 [1] will be evaluated as a representative embedded device for the smart vase, which obtains the data from humidity and temperature sensors and makes modifications according to the data and the pre-installed baseline. The paper aims to summarize critically about existing approaches that reads data from sensors and gives the feedbacks to the controller by analyzing the data.

Related Technology and Implementation

- Obtaining the input and output sensor value

  To collect data about the humidity, the temperature and the light situation in the vase, three sensors will be wired to the Raspberry pi 4. By connecting the three sensors to their corresponding port on the grovepi that built on the Raspberry pi 4, the real-time data from these sensors can be easily obtained by importing the grovepi in Python. It allows users to read sensor values with a function "grovepi.analogRead(sensor_name)".[3] The functions "grovepi.pinMode(sensor_name, "INPUT")" and "grovepi.pinMode(sensor_name, "OUTPUT")" defines which sensor is the input value and which sensor is used for output. The input values are used for analyzing the condition of the plants, and the output is the feedback signal to control the plant environmental system.

- Creating Database

  Google Firebase [2] is a backend service for users to build a real-time database for a real-time phone app. It provides real-time database, user authentication, and hosting. Creating a google firebase is available online through the link https://firebase.google.com/. Choosing the database to be "realtime database" other than the "cloud firestore" is an essential step. By using the security code, the database could be accessed from the Raspberry pi 4. [3] To add real-time data obtained by the Raspberry pi 4, the first thing to

do is importing the firebase from the firebase. Then, the function "firebase.put(system_name, data_category, data)" will update the real-time data that obtained by the grovepi to the online database, and those data could be retrieved by the get function "firebase.get(system_name, data_category, data)" in the Python script of the Raspberry pi 4. With the real-time database, it is easy to create an app for users to monitor daily the plant growing condition and enables the notification for adding waters or nutrition.

Commercial Application of Microcontroller in IoT Smart Vase

The application of using microcontroller in IoT smart vase is not common. Instead of taking care of the plants, most of the "smart vases" are only functioned to play music or change the vase body color [4]. A few commercial smart vases are designed to take care of the plants, but the price is high for home usage. Brand Gardyn has a series of competitive smart gardener products [5] such as the "GARDYN EXPLORER", "GARDYN HERO", and "GARDYN HERO PLUS". Their price are around one thousand dollars each even after the discount applied. Gardyn smart gardener allows customers to choose the type of plant in their Gardener app and provides the corresponding growing solution and seeds for users. The app will notify the users when more water or nutrients are needed by monitoring the growth of the plants with sensors.[6] All growth data are recorded on the Gardyn app.

Strengths of Gardyn

1. Three different size that are available for customers to choose. The flexibility of size fits customers' needs and does not waste the place in home and the spots on the vase.
2. The vertical design has two benefits. It allows more plants to grow on the vase with less occupation. In addition, the sunlight and the temperature controller can maximize the energy usage by having two circular rings on each side of the vase since the circle creates the largest area with the same perimeter.
3. The design of the app that monitors the plants is simple and easy for the customers to understand. It reminds users to add water and nutrition and notifies the time to harvest. The app will help users to save a large amount of time for taking care of the plants.

Weaknesses of Gardyn

1. The price is high. Among the three products, the cheapest one is around eight hundred dollars, and the most expensive on is around fifteen hundred dollars. It might be worth for some business or luxury situation, but it does not fit well for daily usage.
2. The vase does not provide the choice of flowers. Most families might be willing to have some flowers growing with other green plants. The lack of flower growing choice would make the vase lose a large number of customers.

References

[1] Raspberrypi, "Rpi_DATA_2711_1p0_preliminary". Raspberry Pi 4 Model B datasheet, June 2019.

[2] Tamplin, James, "Firebase expands to become a unified app platform". Firebase, Inc. 2016. [Online]. Available: https://firebase.googleblog.com/2016/05/firebase-expands-to-become-unified-app-platform.html. [Accessed Oct. 9, 2020].

[3] Technovation, "Raspberry Pi Powered IOT Garden". *instructables.com.* 2019. [Online]. Available: https://www.instructables.com/Raspberry-Pi-Powered-IOT-Garden/. [Accessed Oct. 9, 2020].

[4] OHNICE. "Music Plant Pot, OHNICE Wireless Bluetooth Speakers 360°Surround Sound Music Smart Flower Pot, 7-Color LED Night Light Lamp by Touching Plant for Bedroom Home Office". a*mazon.com.* 2020 [Online]. Available: https://www.amazon.com/OHNICE-Wireless-Bluetooth-Speakers-360%C2%B0Surround/dp/B07WYJKG7T. [Accessed Oct. 9, 2020].

[5] Gargyn. "Shop now". *mygardyn.com.* 2020. [Online]. Available: https://mygardyn.com/buy-now/. [Accessed Oct. 9, 2020].

[6] Gargyn. "How it works". *mygardyn.com.* 2020. [Online]. Available: https://mygardyn.com/how-it-works/. [Accessed Oct. 9, 2020].