An Experimental Mixed Reality System for IoT Testing

MANA TABEI[†1] IKUTA TANIGAWA[†2] MIKIKO SATO[†1]
TAKESHI OHKAWA[†1] HARUMI WATANABE[†1]

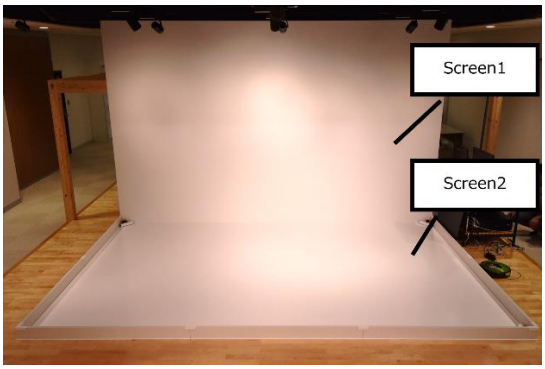
Keywords: IoT, Mixed Reality System, Context-Oriented Programming

1. Introduction

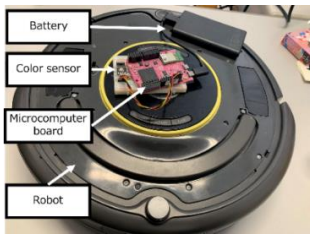
Recently, the IoTs are widely used and help to make a precious life. Such systems need to support the adaptation problem for giving services to depend on changing surrounding environments. Thus, the testing of IoTs needs to provide many environments as test cases. However, we cannot easily provide many environments. To solve this problem, we have built a mixed reality system that consists of two screens for virtual environments and several real robots [1]. In this mixed reality system, real robots collaborate with virtual images. For example, if a virtual robot works to pick up a red box, the real robot moves to the red area. Meanwhile, if the virtual robot picks up a blue box, the real robot moves to the blue area. The final goal is to provide a framework of mixed reality for easily giving such cooperative virtual environments. We think the framework helps to create test cases for IoT robot systems easily. To build the framework, we evaluate the performance of its sensors and communication. The remainder is organized as follows. Sections 2 explains our approach. Finally, section 3 concludes this article.

2. Mixed Reality System

The mixed reality system consists of a virtual system in Figure 1 and several real robots as shown in Figure 2. The virtual system is divided to two screens for projecting the surrounding environments. As shown is Figure 2, we choose iRobot Create 2 Programmable Robot for the real robot, because we have provided educational materials. The robot is equipped with a color sensor, and microcomputer board for connecting Wi-Fi. The robot is controlled by PC through Wi-Fi communication. The robot controlling PC connects to another PC for controlling the virtual system.



Figre1. Virtual system

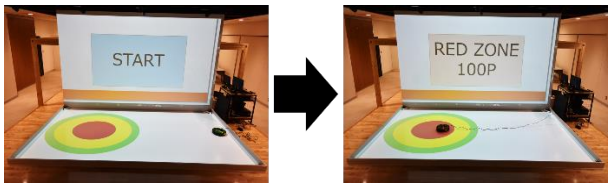


Figre2. Real robot

3. Experiment

To build the mixed reality system as more realistic, we experiment with building several applications on the mixed reality system. In this experiment, 37 students are divided into six groups. Each group constructed a small game. In this game, the robot action and the displayed image are changed according to the color detected by the color sensor. For simplifying the application, the number of sensor colors is limited to eight.

Figure 3 shows an example. In this example, the robot goes straight five seconds. Then, the robot Stops. Next, the color sensor detects color. Finally, displayed comments to depend on color. In figure3, the robot stopped in the red zone. Thus, the robot displayed the comment “red is 100 point”. In those results, sometimes, the robot was not aware of the color correctly. We consider the reason is a delay for the turnaround time between the robot and the virtual system.



Figre3. Example of games

4. Conclusion

Towards a testing framework for IoT, the article introduced a mixed reality system and an experiment. In this experiment, students built six games. In those results, sometimes, the robot was not aware of the color correctly. In future work, we will analyze the result of those applications' behavior, apply it more realistic application. Moreover, we will apply the mixed reality system to other hardware.

Reference

[1]Ikuta Tanigawa, Harumi Watanabe, Nobuhiro Ohe, Mikiko Sato, Nobuhiko Ogura, Takeshi Ohkawa , Kenji Hisazumi, Akira Fukuda: Context-Oriented Live Programming Environments with Mixed Reality System for IoT Education, LIVE’19 workshop co-located with SPLASH, 2019.

†1 Tokai University

†2 Kyushu University