The research of AR System for introducing Industrial Robots

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Abstract

In recent years, Japan has been suffering from a labor shortage in all industries. By introducing robots, it is possible to reduce manpower, and it is expected to contribute to resolving labor shortages. However, the introduction of industrial robots is not easy due to the high cost of equipment and system integration. Therefore, we are developing an Augmented Reality (AR) application for the purpose of introducing robots. In this study, we developed a mobile AR system that can check the movement path of a robot when it is introduced without using the actual robot and confirmed its operation.

Keywords: AR, Factory Automation Robots, Unity, ROS

1. Introduction

In recent years, Japan has been suffering from a labor shortage in all industries, not only in the manufacturing industries. The main cause of the labor shortage is said to be the decrease in the working population. By introducing robots to production lines instead of people, it is possible to reduce manpower and improve productivity, and it is expected to contribute to resolving labor shortages. On the other hand, the introduction of robots into a company requires a huge amount of money for system development, installation, and maintenance, as well as for the robots themselves and related equipment. Therefore, the enormous cost (expense and time) is a major barrier to the introduction of robots.

In order to compensate for the shortage of manpower, we develop an autonomous lunchbox serving system using reinforcement learning (Fig. 1). To reduce the enormous cost, we also develop an AR system using 3D data of a robot arm.

AR is a technology that makes it appear as if virtual information that does not exist in the real world is actually present in the real world by overlaying it onto the real world through a mobile device camera or other device. This time we will introduce a 3D model of a robot arm and then move the model. By running this system in a factory, it is expected that it will be possible to easily check traffic flow on-site. In this study, we developed a mobile AR system that can check the movement path of a robot when it is introduced without using the actual robot and confirmed its operation.

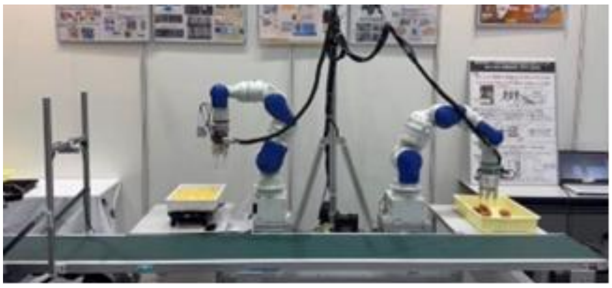
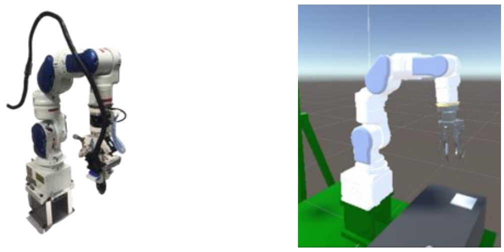


Fig. 1. A self-learning robot for the food industry

2. Methodology

2.1. *Robot Arm*

Yaskawa Electric's MOTOMAN-SIA5F (Fig. 2), we also introduced a 3D model of the same robot arm to the mobile AR system because we are developing a lunch-serving system using same robots.



a. MOTOMAN-SIA5F b. 3D model

Fig. 2. Robot model used in the study

2.2. *Development environment and framework*

The system consists of two main platforms, Unity and ROS (Robot Operating System)[1][2]. Since Unity provides AR Foundation as a framework for AR development, we used it for AR development. ROS provides a variety of functions, one of which is MoveIt, which plans the motion of the robotic arm's hand position and finds the optimal path to reach the target coordinates and orientation. We applied this functionality to a 3D model of a robotic arm in an application [3].

2.3. *Communication*

Unity and ROS use TCP communication to exchange messages. On the ROS side, ROS-TCP-Endpoint, a package for creating an endpoint to exchange messages from Unity, was installed. On the Unity side, ROS-TCP-Connector, a package for creating a connector to exchange messages from ROS.[3]

2.4. *System Overview*

An overview of the system is shown in Fig. 3. The mobile terminal is equipped with a project developed in Unity and converted into a file executable on the mobile terminal.

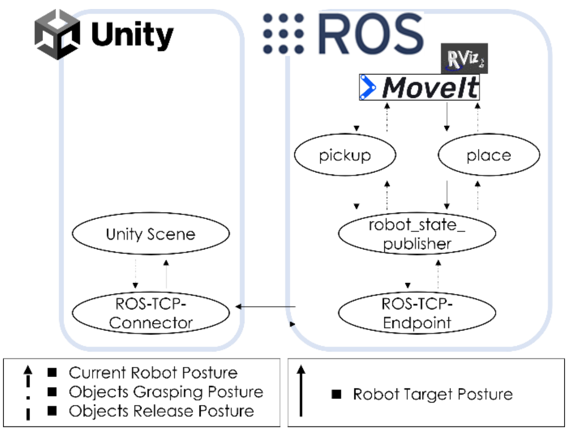


Fig. 3. System Overview

3. Experiment

3.1. *Operation Check*

We checked that the mobile AR system we created was working properly. First, the flow of the created mobile AR system is shown below. When the application is launched, the home screen is first displayed. When the screen moves to the next screen, the camera of the mobile terminal is activated and the robot arm, girders, grippers, and objects to be grasped (hereinafter referred to as “objects”) appear on the screen. When the “Start Simulation” button is pressed, a simulation using a 3D model of the robot arm starts after exchanging messages with the ROS.

The result of the operation after pressing the start button on the mobile terminal is shown in the following Fig. 4.

a. Iitial Sate b. State of grasping an object

c. State in which an object is placed d. State of operation completed

Fig. 4. Mobile AR system screen

In this case, the application flow is as follows: a, b, c and d.

a. Initial Cost
   The camera on the mobile device is activated and the simulation can begin.

b. State of Grasping an Object
   The robot moves to the position coordinates where the object is located and grasps it with the gripper.

c. State in which an Object is Placed
   The robot arm moves the object to the target coordinates and releases the gripper.

d. State of operation Completed
   The operation is completed, and the robot arm returns to the initial state.

4. Conclusion

Through this experiment, we were able to confirm that the robot arm was able to perform the desired operation. Therefore, it was found that the trajectory of the robot arm's hand position up to grasping the object was calculated and simulated more appropriately than with MoveIt cargo. On the other hand, in this mobile AR system, the robot appears in front of the camera when it is activated, so once it appears, the position cannot be adjusted. Solutions include the creation of a UI that allows the robot's position to be adjusted and the introduction of AR markers.

References

1. ROS, Open Robotics, https://www.ros.org/
2. Unity, Unity Technologies, https://unity.com/
3. ROS-TCP-Endpoint, Unity-Technologies, https://github.com/Unity-Technologies/ROS-TCP-Endpoint

Authors Introduction

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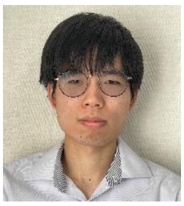

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