'92 KACC 1992. 10. 19~21

A Research on Man-Robot Cooperative Interaction System

A robot teaching method using Hyper Card system

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Abstract

Recently, realization of an intelligent cooperative interaction system between a man and robot systems is required. In this paper, HyperCard with a voice control is used for above system because of its easy handling and excellent human interfaces. Clicking buttons in the HyperCard by a mouse device or a voice command means controlling each joint of a robot system. Robot teaching operation of grasping a bin and pouring liquid in it into a cup is carried out. This robot teaching method using HyperCard provides a foundation for realizing a user friendly cooperative interaction system.

1. Introduction

In the conventional research on an intelligent robot system, making of an autonomous robot is pursued for carrying out all tasks automatically by oneself. A role of a man as an operator is not considered in this system except for master-slave type robot systems.

Recently, realization of an intelligent cooperative interaction system between a man and robot systems is required for accomplishing only one task together by themselves with their features and abilities. In this system, man - robot communicating functions is indispensable for exchanging their commands, advices and comments concerning their operational goals with user friendly interfaces.

As a first step for constructing above system, a robot teaching system with user friendly interfaces is described in this paper. Hyper Card system with voice control is used because of its easy handling and excellent human interfaces. Clicking buttons in the Hyper Card by a mouse device or a voice command means controlling each joint of a robot system. Robot teaching operation of grasping a bin and pouring liquid in it into a cup is carried out by fewer teaching time as compared with to a conventional teaching method.

Consequently, this robot teaching method using Hyper Card system provides a foundation for realizing a user friendly cooperative interaction system.

2. A structual robot teaching system

Teaching is essential in order for robots to carry out various tasks with several kinds of moving sequences. Teaching by showing or guiding is called teaching playback control. An operator moves a robot's hand to a specified position and orientation with a teaching box, and the robot's paths and procedures are recorded in memories. In playback mode, a robot moves its hand repeatedly according to the sequence of these teaching procedures. The teaching playback control method is widely used in many industries and a great deal of operator time and labor is required. The teaching box, however, is not so flexible to expand for various teaching commands easily and must be improved in aspects of user interfaces.

We have developed a structual robot teaching method using Hyper Card system with voice control in a Macintosh computer as showed in ***Fig.1***.

3. Robot control by Hyper Card system

In this system, we use a robot system (*Mitsubishi -MoveMaserEX*) with five degrees of freedom. The robot has six movable parts : waist, shoulder, elbow, list-pitch, list-roll and hand (open or close). The robot has 24 position control commands, 4 hand control commands and 6 reading commands using a RS232C cable and so on. Macintosh computer is connected by a drive unit of a robot system via a RS232C cable.

Hyper Card system of a Macintosh computer is a multi-media information exchangable base software. It has fields for texts, pictures, button for managing cards and sounds. Hyper Talk is a object oriented type programming language of Hyper Card system for stacks control. Its scripts are defined as a attribute of a button. It is designed conveniently to well transform a command from users. For example, an objective of scripts written in Hyper Talk is carried out by selecting a button with a mouse device or a voice command.

It is necessary for robot control to send a serial signal of control commands of a robot system from Hyper Card system of a Macintosh computer. Hyper

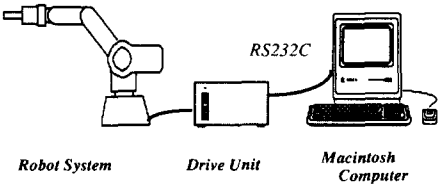

Fig.1 *A Robot Teaching System*

Talk has not such a sending signal command and XCMD : extended command of Hyper Talk, is used. XCMD is a machine language image compiled by C program and added to Hyper Card by ResEdit for high speed processing such as signal sending. We use a Send Signal XCMD for sending serial data. So, we can send a command data to a robot system with 9600 bits/sec. In ***Fig.2*** , we show a example of a button script including XCMD for moving a robot's shoulder part.

```
on mousedown
   global s
   wait   15
   if the mouseclick
   then
      put " SendSerial " & quote & " MJ 0, "
       & field "ms"& ", 0, 0, 0 ^0d"
       & quote into card field " MOVE " of card 3
     do card field " MOVE " of card 3
     add field "ms" to field " nowShoulder "
     put 0 into field "ms"
   end if
end mousedown
```

Fig.2 *HyperTalk script for robot control*

4. Man-robot voice communication

In an intelligent cooperative interaction system, man-robot communicating functions is indispensable for exchanging their commands, advices and comments concerning their operational goals with user friendly interfaces. In this system, we use a voice control utility for accomplishing robot operations by voice command instead of selecting buttons on the Hyper Card. Commands' name must be registered by operator's voice in advance. Besides this operator's voice command, several voice responces from a robot system and a teaching system as follows:
(1) guidance about teaching sequence, (2) report of moving action's results , (3) report of current robot's states, (4) HELP requirement, (5) question and so on.

5. Robot teaching experiment by a structual teaching system

Ideally, operator gives an outline of task to a robot system and robot system must carry out the delicate and complicated works. In practical situation, a man and a robot system have to aid each other mutually with their features and abilities. In ***Fig.3*** , a Hyper Card stack for picking operation is showed for a example. At first, we must teach an approach point to an object. So, we select **Teaching an Approach Point** button to go to a robot teaching stack using for moving six movable joints (***Fig.4***). In left upper side, a control box for waist, shoulder, elbow, pitch, roll and hand part of a robot system is depicted in ***Fig.5*** . User can choose buttons about 'which part he want', 'which direction he want' and 'how many moving amount he want'. These selected operations are carried out by buttons with both a mouse device and a voice command. After we can teach this point in this way, former stack is back and **Teaching a Grasping Point** button is selected. Here, a robot teaching stack is used for teaching a grasping point. At last, operator decide to grasp an object or not.

In robot teaching stack (***Fig.5***), user can select open-close and any grip force of a hand. Robot moving speed can be set and standard pose button means all zero state of all movable parts. In right upper side of this stack, each state of parts at present is displayed. If user select a "GOTO" button, a robot moves to the position of a final set number.

Programming box in right below side of the stack is used for a robot teaching. Robot's hand is moved to the specified point by pushing a botton with only a mouse device using above described methods. After confirming, "SET" button is pushed and that point is registerd as "position 1". Next position's name set by same operation is "position 2". In this way, we can teach a sequence of moving point repeatedly.

"DELETE" botton means erasing mode in case of user's mistakes in position setting. At last, when all teaching positions have been set up, "START" button means that a robot moves from "position 1" to "end position" in turn.

We prepare operation stacks for placing an object on the table and pouring liquid into a cup. Combining these operation stacks, a simple example of a robot teaching program using Hyper Card system described above. At first, a robot grasp a juice bin (***Fig.6***) and pour it into a paper-cup (***Fig.7***). Next, an empty bin is moved to the original position, a robot grasp a paper-cup with juice (***Fig.8***) and place it to the appointed position in ***Fig.9***. These teaching program can be saved by pushing "SAVE" button and keying in that program name. "LOAD" button means that all formerly created program name are displayed. Selcting a requested teaching program, user can carry out it by pushing "START" button.

5. Conclusions

This paper describes research on a coordinave interaction interface between a man and robot systems. As a first step of this research, robot teaching system by using Hyper Card system with a voice control. Simple example of robot teaching is carried out 1/3 teaching time as compared with to the conventional teaching method.

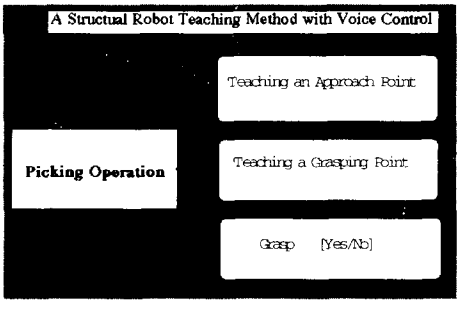

Fig.3 *HyperCard stack for Picking Operation*

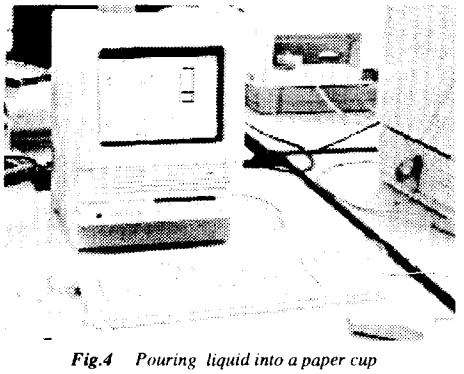

Fig.4 *Pouring liquid into a paper cup*

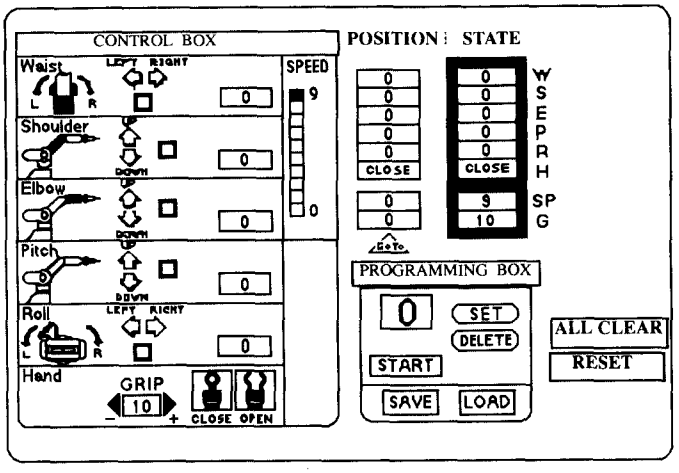

Fig.5 HyperCard stack for robot teaching system

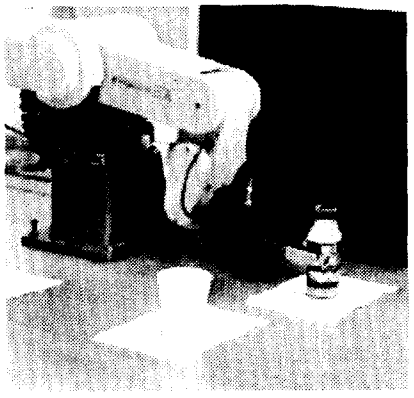

Fig.6 Picking a bin on the table

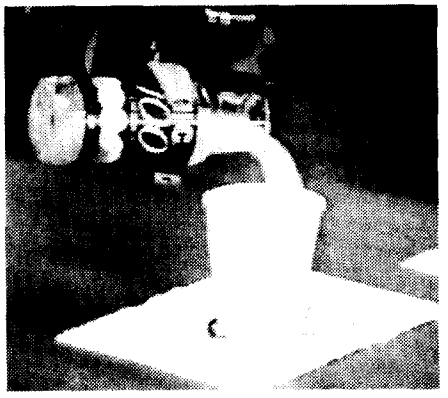

Fig.7 Pouring liquid into a paper cup

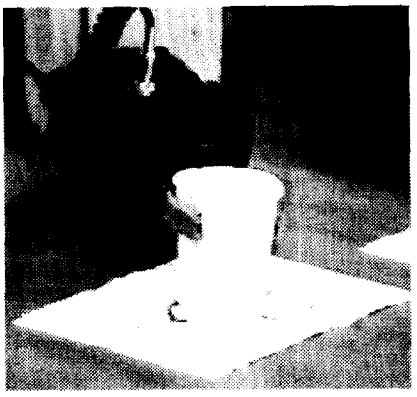

Fig.8 Picking a paper cup on the table

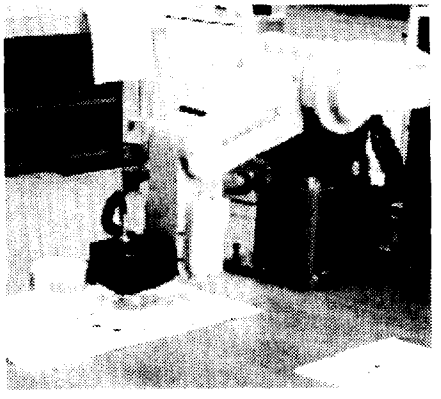

Fig.9 Placing a paper cup on the table