# A Robot Motion Authorization using Finger-Robot Interaction

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**Abstract**—This paper proposes a robot motion authorization using finger-robot interaction. The proposed method is a user- friendly method that easily authors (creates and controls) robot motion according to the number of fingers. The Effectiveness of the proposed motion authoring method was verified based on motion authoring simulation of an industrial robot.

Keywords-finger-Robot interaction,Industrial robot.

## I. INTRODUCTION

With rapid developments in today's robot technology, robots have been used in a wide range of fields. However, robots must become easier to use for general users in order to expand the scope of applications of intelligent robots in our everyday life. Based on this request, a number of studies are being conducted regarding new types of user-friendly and intuitive robot motion authoring that can render various motions. Also, there are research projects actively taking place in human-robot interaction, thanks to the progress that has been made in vision technology. A study is being conducted to develop an finger pad that can replace the computer mouse and there are other studies proposing algorithms to improve hand gesture recognition . This paper proposes a motion authori method using finger-robot interaction. The proposed method is capable of authoring (creating and controlling) robot motion according to the number of fingers. It is an intuitive robot motion authoring method that allows the user to easily author robot motions.The Effectively of the proposed meth od i s veri fi ed b as ed on motion authoring simulation of an industrial robot.

## II. PROPOSED ROBOT MOTION AUTHORIZATION USING FINGER-ROBOT INTERACTION

With the exception of language, the hand is most frequently used for human communication among our body parts such as hands, eyes, mouth, arms and legs. This chapter explains how industrial robot motions can be the authored according to the number of fingers and verifies the effectiveness of the proposed approach based on simulation.

### A.Finger recognition

There are a number of techniques for finger recognition, which is being used in various fields. In this section, finger Reco-gnition unit is implemented using color values scheme. The finger recognition unit first converts RGB colors into gray scales and YCrCb for binary representation. Then the region inside the hand is filled by masking and noise is removed . The binary image is examined in 25-pixel units, as shown in Figure 2. If sum of 1's examined is greater than ten, every digit is set to 1

With the image obtained by masking erformed by the finger recognition unit, the center of the hand can be calculated to identify hand's location as well as the hand region furthest from the center. The center of the hand is marked with a red dot, the palm region with a red circle and the hand region with a white circle. If the number of fingers is 0 or 5, a circle image is displayed. For 1, 2 and 3 fingers, the image is shown in blue, green and red, respectively. If there are 4 fingers, the hand is shown in white on a black background (Figure 3).

gure 1. Conversion of RGB colors into gray scales and YCrCb for binary representation

Figure 2. Image obtained by masking

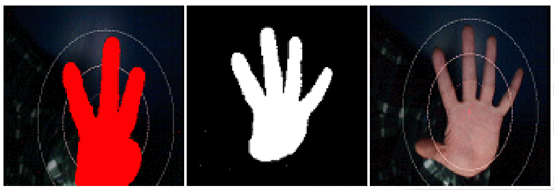


Figure 3. Finger recognition results

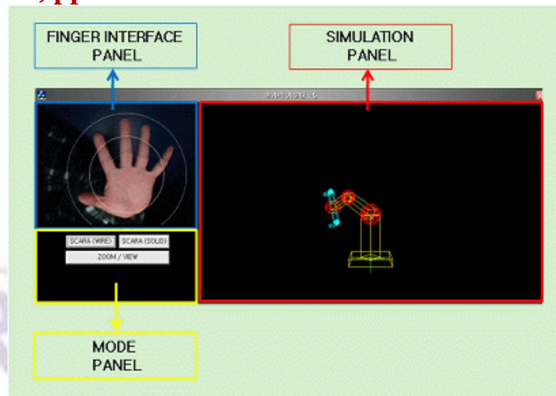



Figure 4. Robot Motion Editor

B. Motion authoring

In this section, a motion authoring unit capable of creating and controlling robot motions (industrial robot in this paper) is implemented using the finger-robot interaction based on the finger recognition unit explained in the previous section. The motion authoring unit(editor) consists of three panels: the finger interface panel, mode panel and simulation panel(Figure 4).

The finger interface panel means the finger recognition unit that recognizes the number of fingers(from 0 to 5) from the finger images taken by camera. The number of fingers recognized by the finger interface panel allows the user to control the industrial robots (such as SCARA, articulated robot, and etc.) displayed on the simulation panel. The mode panel provides three modes – WIRE, SOLID and ZOOM/VIEW.

The WIRE mode allows viewing of robot's internal structure and the SOLID mode only provides robot's external view. In the ZOOM/VIEW mode, the view can be zoomed in/out and rotated, allowing the user to view robot's entire structure in detail. The simulation panel provides the user with a real-time 3D viewing of the robot motion being authored with finger-robot interaction.

Tables 1 and 2 list the definitions of finger-value events for WIRE, SOLID and ZOOM/VIEW mode.

| MODE | FINGE | EVE |
|---|---|---|
| A. WIRE B. SOLID | 0 | defa |
| | 1 | 1-Axis rotation (base |
| | 2 | 2-Axis rotation (base |
| | 3 | 3-Axis rotation (base |
| | 4 | Gripper |
| | 5 | Gripper OFF |

| MODE | FINGE | EVE |
|---|---|---|
| C. ZOOM/VIEW | 0 | defa |
| | 1 | ZOOM OUT |
| | 2 | ZOOM |
| | 3 | VIEW rotation (CW) |
| | 4 | VIEW rotation |

Table 2. Definitions of Finger-value events for ZOOM/VIEW mode.

C. Motion authoring simulation

This section evaluates the effectiveness of the proposed authoring method based on robot motion authoring simulation. The industrial robot used for the robot motion authoring simulation is an articulated robot with 3 DOF, and its motion ranges and definition are given in Table 3 and Figure 5.

Table 3. Motion Range

| | ANGLE |
|---|---|
| 1- | 0~36 |
| 2- | 0~9 |
| 3- | 0~9 |
| Grippe | O |
| | OF |

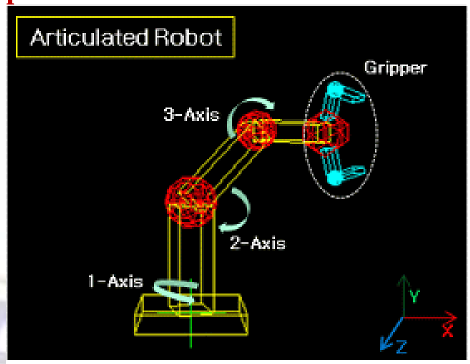



Figure 5. Definition of an articulated robot used for the motion authoring simulation

In WIRE and SOLID mode, internal and external structures of the robot can be viewed, respectively. In either mode, if the number of fingers recognized by the finger interface is 0, the robot is initialized to the default value. Iffinger is recognized, 1-Axis rotates around the Y axis. For 2 or 3 fingers, 2-Axis or 3-Axis rotates around the Z axis, respectively. The ZOOM/VIEW mode allows the user to zoom in and out of the robot structure and vary the camera angle for a detailed view. Similar to the WIRE mode, the camera is rotated clockwise and counter-clockwise for 3 and4 fingers, respectively, according to the definitions of Table2 so that the user can view the robot from a desired angle.Accordingly, the user is able to not only create but control motions for a part of a robot based on the number of fingers recognized. Figure 6 depicts how a robot part is enlarged in the ZOOM/VIEW mode when the number of finger is recognized as 2.Figure 7. Robot motion authoring process using the proposed method

## III.CONCLUSIONS

This paper proposed an authoring method capable of creating and operation controlling motions of industrial robots based on finger-robot interaction. The proposed method is user- friendly and intuitive and facilitates motion authoring of industrial robots using fingers, which is second only to language in terms of means of communication. The proposed robot motion authoring method is expected to provide user-friendly and intuitive solutions for not only various industrial robots, but also other types of robots including humanoids.

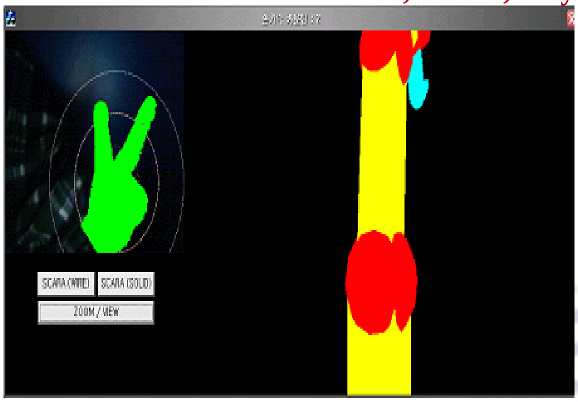
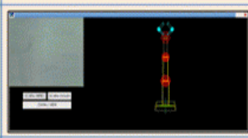
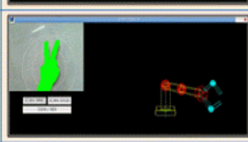
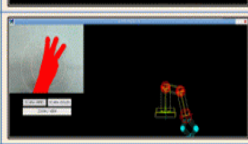
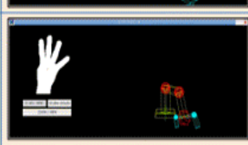



Figure 6. Enlarged robot part in ZOOM/VIEW mode with 2 recognized

Furthermore, authoring was effective because different colors were displayed according to the number of fingers recognized, allowing the user to immediately discern the part of the robot being authored. Figure 7 is a captured image of the robot motion authoring process using the proposed method.

| Finger Number | Simulation State | Motion Value (degree) |
|---|---|---|
| 0 |  | 1-Axis : 0<br>2-Axis : 0<br>3-Axis : 0<br>Gripper : OFF |
| 1 |  | 1-Axis : 45<br>2-Axis : 0<br>3-Axis : 0<br>Gripper : OFF |
| 2 |  | 1-Axis : 45<br>2-Axis : 90<br>3-Axis : 0<br>Gripper : OFF |
| 3 |  | 1-Axis : 45<br>2-Axis : 90<br>3-Axis : 80<br>Gripper : OFF |
| 4 |  | 1-Axis : 45<br>2-Axis : 90<br>3-Axis : 80<br>Gripper : ON |
| 5 |  | 1-Axis: 45<br>2-Axis : 90<br>3-Axis : 80<br>Gripper : OFF |

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