

## K6-90

## Demonstration and Mechanism of Transformation Type Humanoid Robot

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Abstract: This paper presents a humanoid robot having a transformation mechanism for entertainment applications. The body height of the robot is 48 [cm]. Fabricated robot is realized the transformation of the power shovel form from the humanoid form. The mechanism of the fabricated robot is eliminated the dispersion of the servomotor caused by the transformation, and reduce the load on the servomotor. This robot demonstrated the motion like a conventional humanoid robot. Moreover, after the transformation, it is shown the characteristic motion like a power shovel. The fabricated transformation type humanoid robot will be performed at the robot show.

### 1. Introduction

Robots of various types have been developed, and these robots have used actively in our society. For example, there is the disaster relief robot capable of performing the work in the field that is difficult to enter by humans. Moreover, the animal type robot for therapy is used in the medical field. In addition, performance robots for entertainment have also been studied. A musical instrument playing robot that can play the violin was reported<sup>[1]</sup>, and TOYOTA made ASIMO as humanoid robot.

We focused on the entertainment robot, and the transformed mechanism is focused as a method of performance improvement because the most important factor is the impact for the entertainment. In addition, the safety of the entertainment robot is required.

Therefore, in this paper, the humanoid robot that having a transformation mechanism is developed. Moreover, the designed robot has compacted the center of gravity for the safety of the robot.

### 2. Mecanism and Process of Transformation Type Humanoid Robot

The robot that can realize the transformation of the power shovel form from the humanoid form is developed. The robot is constructed by the humanoid body and the catapilar parts for the power shovel form. The catapilars are atached to the outside of each foots. Figure 1 shows an axial arrangement of the humanoid robot having a transformation mechanism. The robot when formed the humanoid type has 25 degrees of freedom. Two motors for the transformation are arranged in the bust part. These motors act a important role as moving the each arm for transformation. The waist

part that has a large stress are held by two motors. Used servo motors and the control board are KRS-2552RHV and RCB-4HV of Kondo Kagaku Co. Ltd.. They have a characteristics of high torque, small size and cheap to use easy. In addition, caterpillar unit made by Tamiya Co., Ltd. is used, and two DC motors as actuators are used.

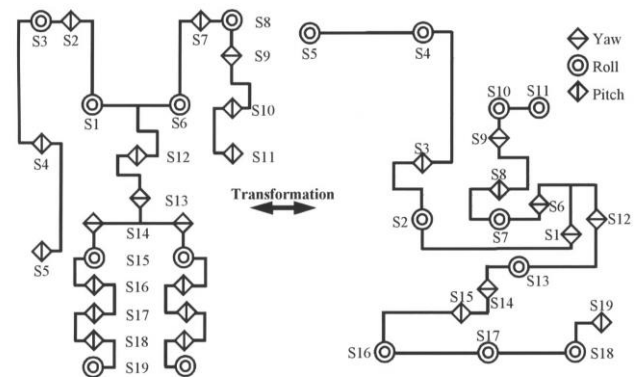


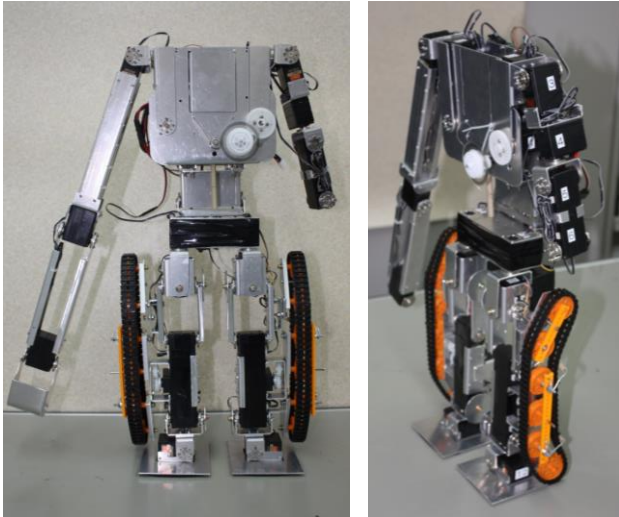
Figure 1. Axis placement of the humanoid form robot

In the design process, 3D CAD design software was used. This software is efficient because of that can be simulate of the transformation process and assembled. After that, the parts designs were made by two-dimensional CAD software. The developed robot is constructed by aluminum plate. The components were fabricated by the NC machining. The thickness of the aluminum plates were changed for each part of relationship between the strength. For example, parts of shoulder, ankle, and so were fabricated by 2 [mm] thickness aluminum plate. Also, parts of the other were fabricated by 1.5 [mm] thickness aluminum plate.

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### 3. Results

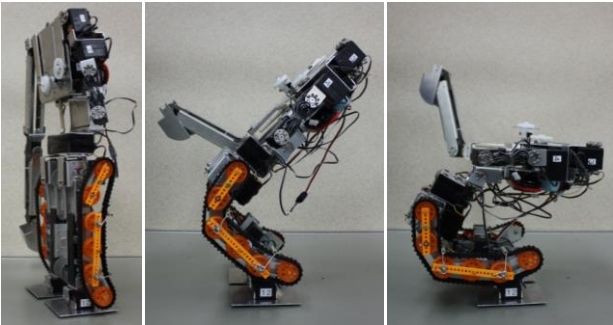
Figure 2 shows the fabricated humanoid robot having a transformation mechanism. Figure 3 shows transformed motion of the humanoid robot to power shovel form from the humanoid form.



Front view

Side view

Figure 2. Conversion type humanoid robot, which was completed



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Figure 3. Transformation motion of the fabricated robot

When transforming the robot, there is transformation method lumbar region of the humanoid into U-shape for transformed. In this case, if the servo motor hold there humanoid form, become overloaded with the servo motor of

the waist. In addition, the rotation of the upper body by center of body is one of special movement of power shovel. However, it can not even. And so to realize the rotational movement of the upper body of the body center without putting a load on the waist when power shovel form to I embedded servo motor to the chest of humanoid form at the time. By linking the shoulder of the humanoid form at the time and embedded servo motors, as per Servo motor of the upper body is collected in the center of the body. For this reason, when power shovel form, servo motor of a main cause of the weight of the robot because it is collected on a vertical line on the waist of the humanoid form. And load to the servo motor of the waist in humanoid form at the time can be reduced. In addition, rotational movement of the upper body in the center of the body in the power shovel form at the time also becomes possible.

### 4. Demonstration by Humanoid Robot Having a Transformation Mechanism

In our laboratory have done volunteer work of the demonstration, and the appeal activities, in a robot that has to own for the general public at every year. Fabricated humanoid robot intends to participate in these activities.

### 5. Conclusion

We fabricated the transformation type humanoid robot into power shovel form from humanoid form. We are planning to carry out performance by this robot in the future.

### 6. Reference

[1] Satoshi Higaki, Hironoshin YAabu, Takeshi Yamada, Koji, Shibuya (Ryukoku Univ.), Study on Violin Playing Robot, Conference Digest of ROBOMECH 2013, pp.244 2P1-Q01, (2013)