ZSTT Team Description Paper for Humanoid Adult-size League of Robocup 2017

Jaesik Jeong, Youngsup Oh and Jeehyun Yang

ZSTT
E-mail: soulmatree@gmail.com
Web: www.soulmatree.com

Abstract. This paper describes our first adult sized humanoid specifications and functions developed by team ZSTT. We explain hardware, software, design of out humanoid at Robocup 2017 to be held next year in Nagoya.

1 Introduction

This paper is written in order to participate in Robocup 2017. Our robot (SBY) is autonomous humanoid, which is a 1.35m tall and 12kg. It constructed as a 20 degrees-of-freedom biped humanoid. SBY's basic walking algorithm is inverse kinematics and the robot has stable walking algorithm using reinforcement learning. . In the case of walking on the rough surface, gait control is the most important factor for stable walking. There have been many studies about stable walking. Generally, humanoid walking solution is to use inverse kinematics, dynamics, inverted pendulum and ZMP (Zero Moment Point). SBY's swing value is obtained to adjust data of IMU to Q-learning. The software architecture consists of walking gait, image capture, image recognition, localization of the ball and the goals.

2 Hardware

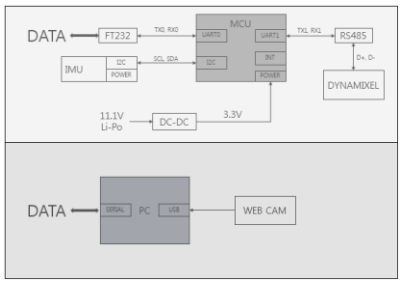

Fig. 1. SBY Block Diagram

SBY block diagram (**Fig. 2**) is divided into 2parts: humanoid controlling hardware and software on PC, which identifies input data coming from IMU and webcam, controlling servo-motors to accomplish missions. Hardware is composed of IMU for the robot's status recognition, servo-motors for moving the robot, DC-DC for regulating voltage, and FT232 used for network. Software (PC) processing is used in real-time for image processing and walking.

Mechanical structure is composed of aluminum alloy parts, 20 Degree-Of-Freedom which is 6 RX-64, 18 MX-106, 2 RX-24F and 2 DX-117 Dynamixel motors. SBY is 136 centimeter tall and 12.5 kilogram weight.

Hardware modules of SBY are a computer (Lattepanda), a web camera (C930e), IMU module, an ARM7 embedded motion controller, and RC servo motors. The hardware specification is shown in **Table. 3**.

Table. 4. SBY Specification

HEIGHT(cm)		136
WEIGHT(kg)		11.5
DOF	LEG	10
	HEAD	2
	ARM	8
ACTUATOR		MX-106, RX-64, DX-117, RX-24F
SENSOR		9-AXIS IMU
CAM		C930e
MAIN CONTROLLER		LATTEPANDA
MOTION CONTROLLER		ARM7(ATMEL)
WALKING SPEED		20cm/s

Fig. 2 is our prototype robot design. This robot is not completed yet. We plan to upgrade the hardware lighter and more robust.

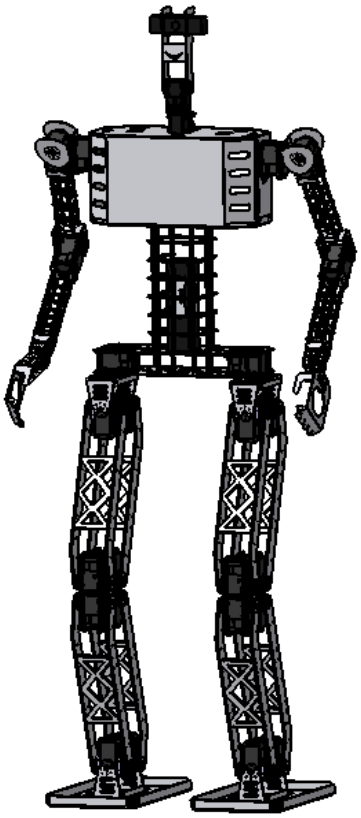

Fig. 2. SBY 3D Design using CATIA

3 Motion

We found swing for a stable gait of a humanoid robot without complicated calculating and precise parts. A Study on Activation of our learning instead of a dynamic analysis had minimized the controller resources. The humanoid is optimized walking algorithm to be carried out in microprocessor. Our humanoid is applied basic walking motion and we found the swing value of using the reinforcement learning. Software making a basic walking motion is available calculation kinematics, simulating invented pendulum, and showing the output of sensor data. Software and Humanoid are connected by serial communication, software send humanoid data (stride, speed, foot height, turn, direction) to solve kinematics.

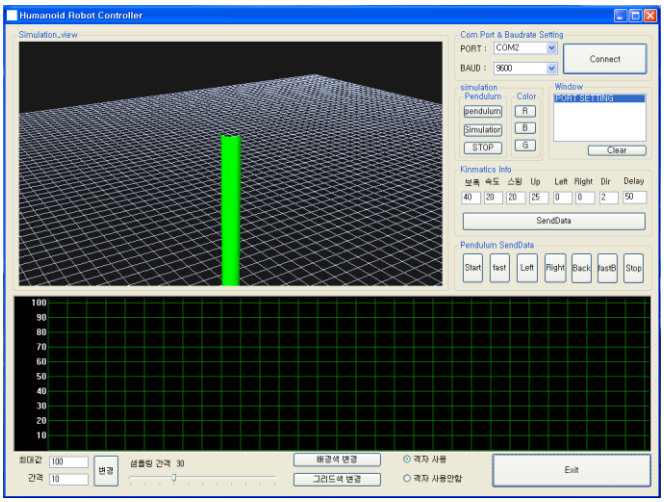

Fig. 3. Walking Motion Software

4 Vision

The vision system of this adult size robot use a Logitech C930e HD camera. Our robot vision system is based on OPENCV. Recognizing the ball and the field, Image processing corrects the position of the robot. The Hough-circle algorithm finds the ball, recognizes the field through color detection and edges. The exact position of the robot is determined through the recognition of the IMU's magnetic sensor and recognized field. **Fig. 3** shows the image processing software.

Fig. 3. SBY Image Processing Software

5 Conclusion

Building on previous research and FIRA Hurocup experience as well as using the technology from the robots of ZSTT, we hope to challege SBY that can compete in RoboCup 2017.