Team Description 2010 for team Ro-Pe Adult Size

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Abstract. After participating in Robocup kid size since 2004, team RO-PE now intends to participate in the adult size of Robocup 2010. This paper is a brief description of the adult size robot NUSBIP-III ASLAN, developed by team RO-PE. Its hardware specifications, control architecture, and algorithm are described.

Keywords: Bipedal robot, humanoid, specification

1 Introduction

There has been numerous bipedal robot in different sizes developed as the platforms of researches by the Legged locomotion Group (LLG) of National University of Singapore (NUS). Among the smaller platforms are the RO-PE I-VI series, which has been participating in Robocup kid size. Besides this smaller platform, LLG also has been developing the human-sized bipedal series, called NUSBIP.

The NUSBIP-III ASLAN is the latest, third generation of NUSBIP series. It has been developed since early 2008. It is developed mainly as a general platform for typical bipedal research such as bipedal walking gait and human basic movements. Robocup 2010 will be held in Singapore, which is a perfect opportunity for NUSBIP-III ASLAN to make its first debut in soccer competition.

2 Specification of NUSBIP-III ASLAN

2.1 Hardware Specification

ASLAN significantly improves the existing physical bipedal robot, NUSBIP-II, especially in the physical structure and the actuator subsystem. The structure of the legs has been improved and the joints are upgraded using the harmonic drives system. By using harmonic drive, ASLAN has achieved stable dynamic walking motions.

Next, two arms and one waist joint have been added on the body, and new sensors have been added into the system. Figure 1. shows the front view of ASLAN.

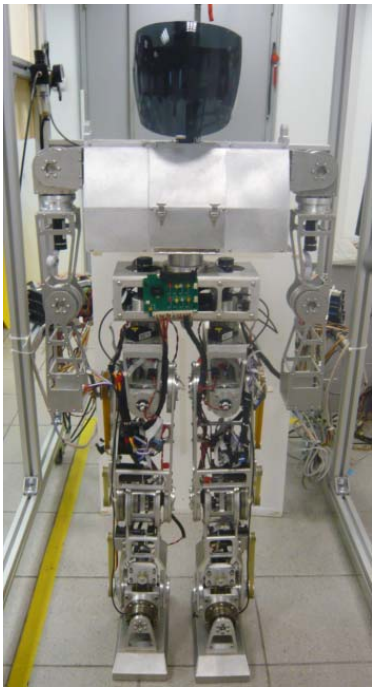

Fig. 1. Front view of NUSBIP-III ASLAN

Overall, ASLAN is a humanoid robot modeled after a child. It has a trunk with two legs, two arms and one waist joint. Its weight is approximately 60kg and hip height is around 0.7m when the robot is standing. The robot has six DOFs on each leg: three at the hip, one at the knee, and two at the ankle; four degrees of freedom on each arm: three at the shoulder, one at elbow. The DOFs at the hip allow the leg to twist and adduct/abduct, as well as swing forward and backward. The DOF at the knee allows the leg to flex. The DOFs at the ankle allow the foot to pitch and roll. All the joints are driven by DC servo-motors with harmonic drive.

As for the sensory system, there is a force/torque sensor on each foot to provide the center of pressure location. Absolute encoders on each joint provide the initial condition for the robot. Digital encoders mounted on the motors will be used to indirectly measure the joint positions. Three-axis rate gyro and three-axis accelerometer will be mounted on the trunk to measure and provide inertia data of the body.

The Solidworks drawing of the ASLAN is shown in Figure 2 and the specifications of ASLAN is shown in Table 1.

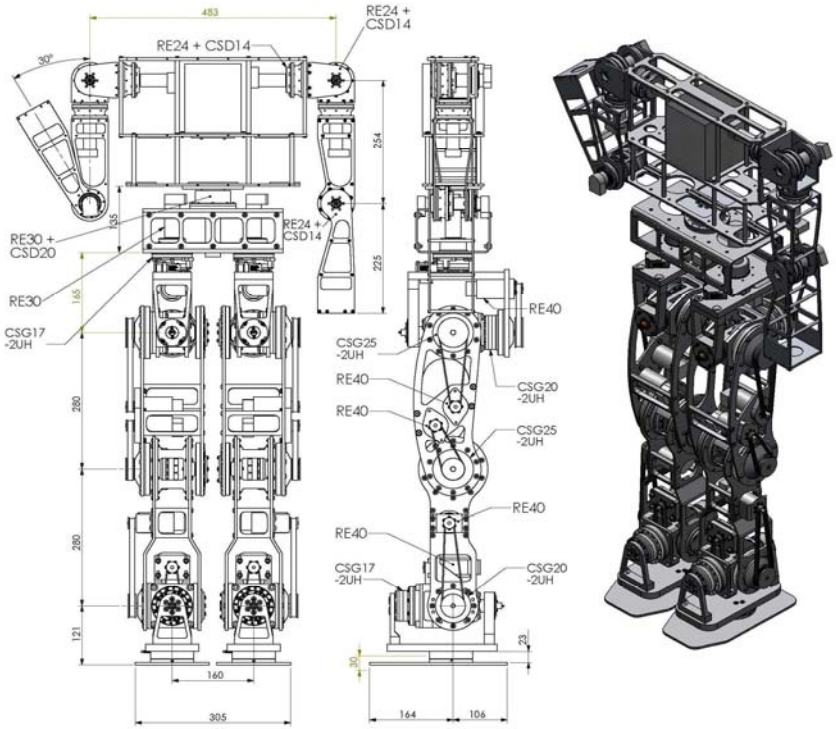

Fig. 2. Solidworks drawing of NUSBIP-III ASLAN

Table. 1 Specification of NUSBIP-III ASLAN

Height	1350mm
Width	550mm
Weight	60Kg
Walk speed	0.3m/s
Actuator	servomotor + harmonic gear + drive unit
Control Unit	PC/104 + Motion control card + DAQ card
Sensor	foot: 6-axis force sensor torso: gyroscope, acceleration and sensor
Operation system	Windows XP RTX

2.2 Control Architecture

PC/104 is used as the main processor to generate the command signal through PC/104 bus. The motion control cards receive the command signal and then send the control signal to amplifiers to drive the motors. Sensory information, such as gyros, accelerometer, force/torque sensors and absolute encoder is read by DAQ card and sent as feedback to PC/104 through PC/104 Bus. The control structure is shown in Figure 3.3.

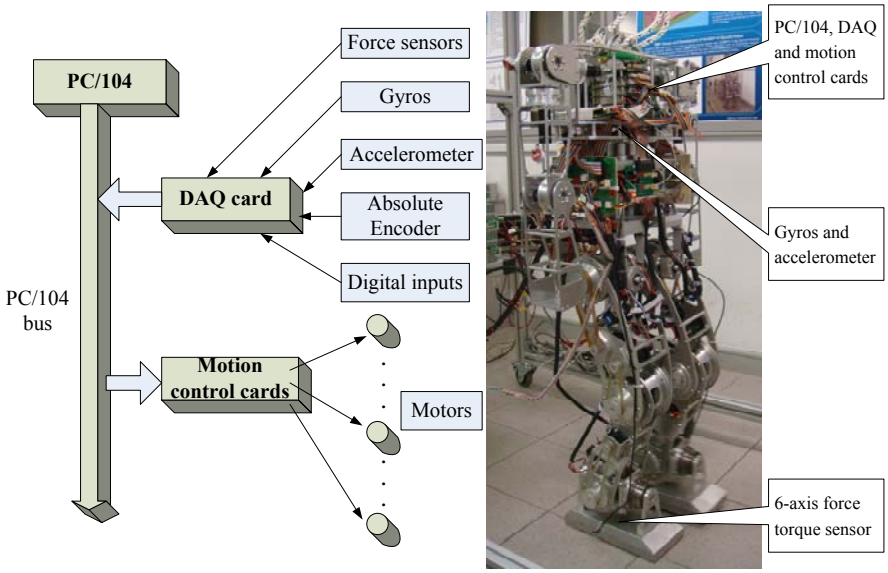

Fig 3. Control architecture of ASLAN

2.3 Algorithm

We will use the experience obtained from the kid-size competition to develop the strategy for the adult size. For the adult size, the robot will need to locate the ball behind itself, approach the ball, and slowly bring the ball closer to the goal before kicking it to score a goal. The following flowchart shows the strategy that is used to locate, approach and kick the ball.

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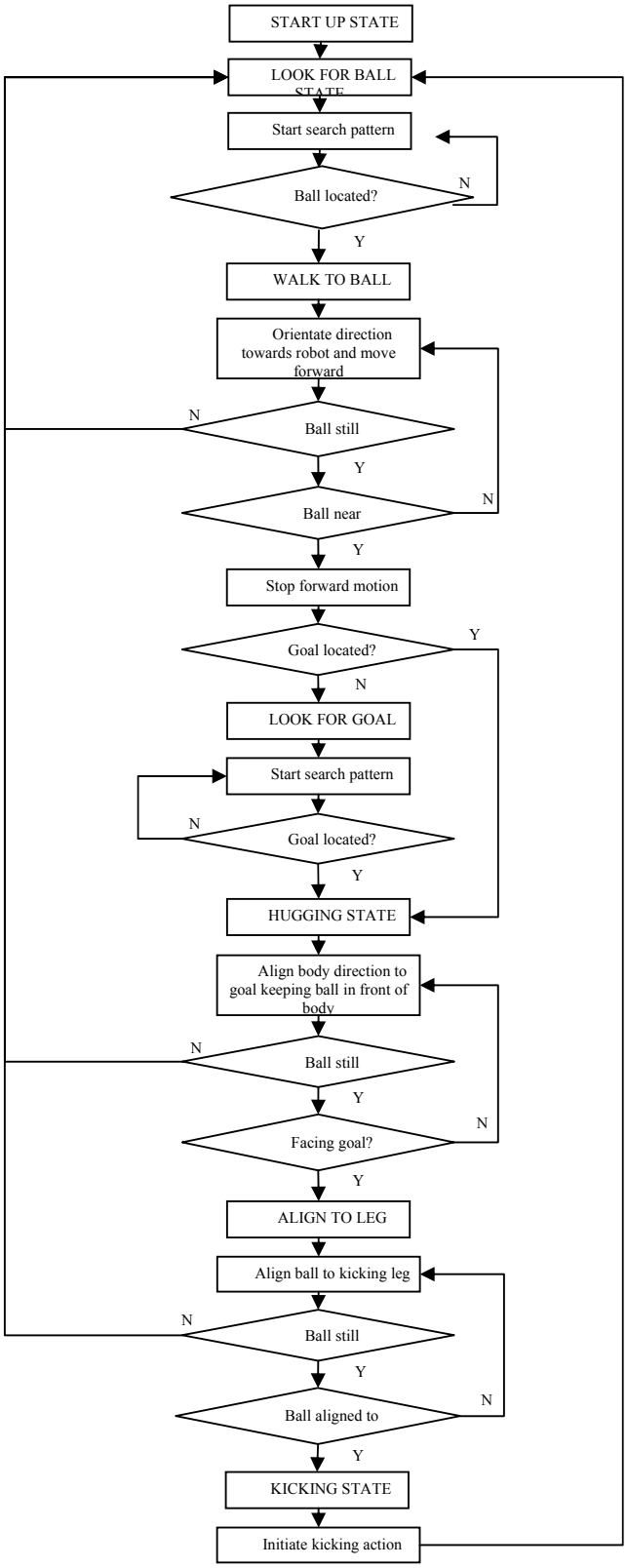
START UP STATE
LOOK FOR BALL STATE
Start search pattern
Ball located?
N
Y
WALK TO BALL
Orientate direction towards robot and move forward
N
Ball still
Y
Ball near
N
Y
Stop forward motion
Goal located?
Y
N
LOOK FOR GOAL
Start search pattern
N
Goal located?
Y
HUGGING STATE
Align body direction to goal keeping ball in front of body
N
Ball still
Y
Facing goal?
N
Y
ALIGN TO LEG
Align ball to kicking leg
N
Ball still
Y
Ball aligned to
N
Y
KICKING STATE
Initiate kicking action

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