JoiTech Team Description

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Abstract. In this paper, we describe the structure of our humanoid robot soccer team JoiTech to participate in the RoboCup 2011 AdultSize Humanoid League competition. Our team gathers two universities in Osaka, Japan, that is Osaka University and Osaka Institute of Technology, and one company Vstone Co.,Ltd. The platform named Tichno-RN is developed by Vstone. It consists of 22 degrees of freedom, fully electronically actuated, and several sensors, such as image sensor, 2-axis gyro sensors, 3-axis acceleration sensors, and potentio meters. The software architecture constists of the modules of image capture, image recognition, localization of the ball and the goals, decision making, motor controls and so on.

1 Introduction

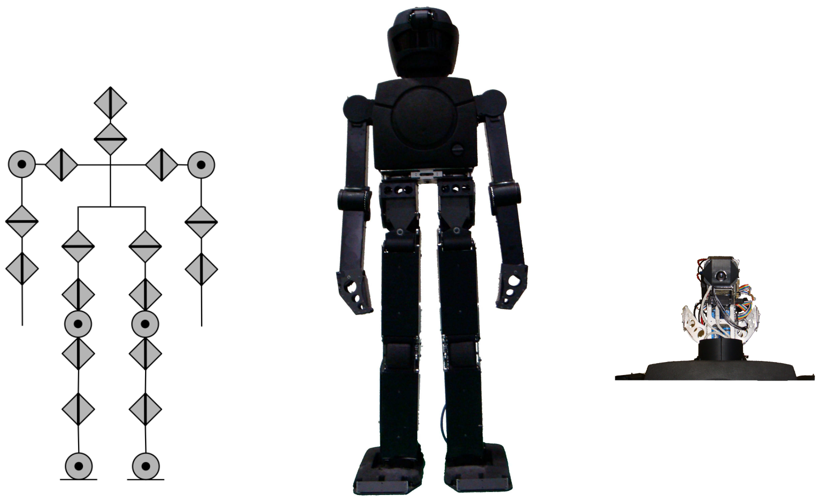
Team JoiTech is originally derived from RoboCup team JEAP, which participated in competitions of Humanoid League KidSize class since 2006[2]. Team JEAP is composed of master's and doctral students at Emergent Robotics Laboratory, Osaka university. Team JoiTech is a derivetive of team JEAP, and we started up a new team in cooperation with students at Osaka Institute of Technology since RoboCup JAPAN OPEN 2010. The team name, JoiTech, is an acronym for "**J**EAP and **O**saka **I**nstitute of **Tech**nology", and it also means "joint team with Osaka Inst. of Technology" and "enjoy technology".

The main goal of our lab is to understand the cognitive developmental process of humans based on synthetic approaches with humanoids. Our lab adopted an adult sized robot, Tichno-RN, as a research platform, which needs to be tested for the studies of this purpose. One of the research issues is advanced dynamic biped walking. In this paper, we describe hardware specifications in section 2, and the software specifications is described in section 3.

2 Robot Hardware

In this section, we describe hardware specifications of Tichno-RN. Mechanical structure of Tichno-RN is developed by Vstone Co.,Ltd. The remarkable features of this robot are its smoothly fast movements even its size and fully autonomation based on sensory information. The electronic motors of Tichno-RN are developed in order to generate stronger torque stably. The covers of the motors are made of aluminum and help the dissipation of the motor heat. Therefore, they can stay in action during a game without breaking down. Further the actuator has a microcontroller and communicate with the main controller through serial connections. So the main controller can receive various information, such as angular position of each joint, temperature, speed.

The front view and schematic overview are shown in Fig.1. Tichno-RN has 22 degrees of freedom. Its detailed specification is given in Table1.



(a) DOF configuration (b) The front view (c) The camera

Fig. 1. Tichno-RN: (a) A schematic overview of the actuators and the configuration of the body. (b) The front view of the whole body (c) The camera mounted on the robot

3 Modular software environment

The software of the robot consists of three modules: which are a vision module, a motion module and a behavior module. Fig.2 shows the overall system of the software. These three modules works in parallel during a game.

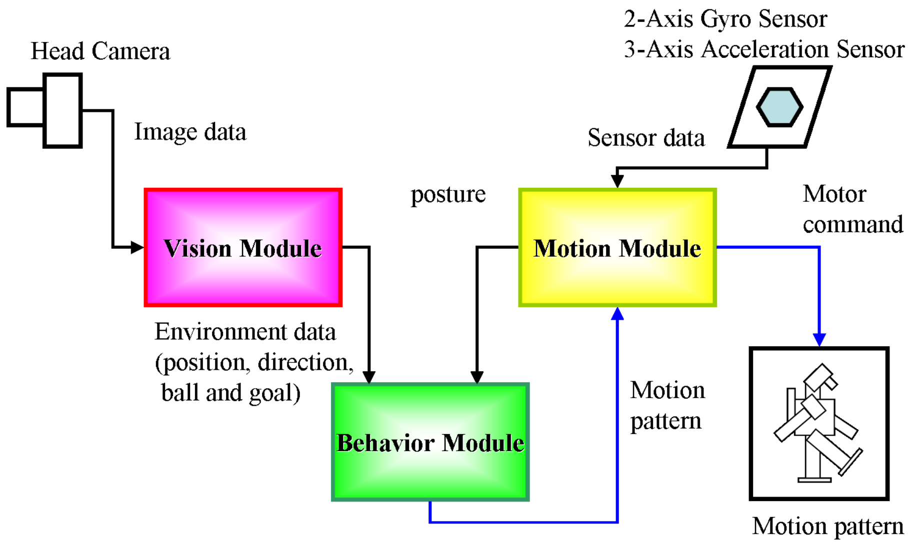


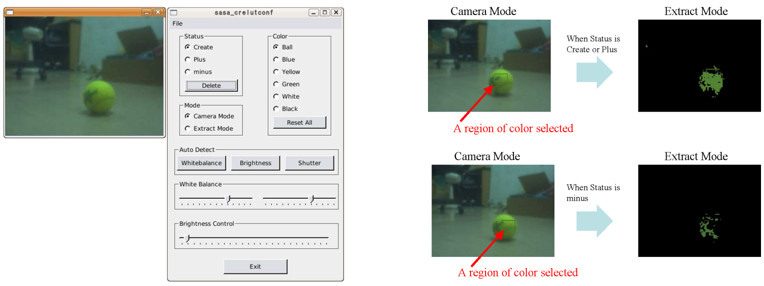
Fig. 2. Overall system of the software: There are three modules. A vision module detects positions and directions of the ball and the goals from image data. A motion module receives postures of the robot from sensor data. Further, it gives motor commands to the robot as a function of the pattern of motion from a behavior module. The behavior module detects the appropriate pattern of motion based on information from vision and motion modulses.

Table 1. Tichno-RN hardware specifications

Tichno-RN		
Height (mm)	1400	
Weight (kg)	25	
DOF	22	
Actuators	VS-SV410, VS-SV1150, VS-SV3310	
Camera Type	SenTech STC-C33USB-BTL	
Controller	Main Controller	Sub Controller
CPU	Panasonic Let's NOTE Core2Duo 1.6GHz	VS-RC003HV ARM7TDMI LPC2148
ROM	222 GB (HDD)	512 KB
RAM	2 GB	40 MB
OS	Windows7	None

3.1 Vision Module

The vision module analyzes image data. We developed a library for the image processing as a vision module. Since the luminance and pixel values of colors sometimes change because of the shadow and lighting condition, it is necessary for robot to know the range of color variation. For this purpose, we implemented a GUI application for setting color variation in the vision module(see Fig.3(a)). By using this system, we can make color table by adding or substracting the range of the values of pixels before the game (see Fig.3(b)). The robot uses it during the game and detects the area of objects wit hout any relation to small differences of the pixel values.



(a) The interface

(b) An example of process of making color table

Fig. 3. GUI application to set up the parameters of the image processing: In order to avoid spending a number of time to set up before the game.

3.2 Motion Module

The motion module analyzes sensor data and to give the motor commands to the robot. Tichno-RN has the 2-axis gyro and 3-axis acceleration sensors. The posture of the robot, which is whether robot is down or not and if so which direction the robot is down, is detected by threshold processing of these sensor data. The motion module also receives the pattern of motion from the behavior module, and translates it into motor commands. In order to create these patterns of motion (e.g. kick, standing up, and so on), we use RoboviMaker, which is software developed by Vstone to handle small CPU board VS-RC003 on the robot(see 4). By using RobovieMaker, we can specify several postures by setting joint angles of the robot with slider bar, a motion is made by sequencing these postures.

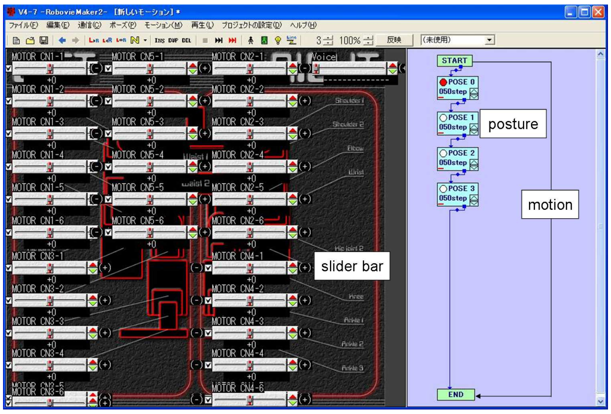


Fig. 4. GUI application to create patterns of motion: In order to create and test a lot of patterns of motion, we use RobovieMaker

3.3 Behavior Module

The behavior module determines the appropriate pattern of motion, depending on the situation. The behavior module sequentially receives the information of the field(ball, goals and its own posture) from the vision and motion modules, and selects the appropriate motion from several motion patterns, such as kicking, approaching, standing up and so on.

4 Self-localization system

We are developing self-localization system for the robots by using field lines based on the Particle filter algorithm[1]. This filter is usually used to estimate Bayesian models and the sequential analogue of Markove chain Monte Carlo methods. In the system, robot's location are estimated in the following procedure:

1. Intersections of radially arranged lines in image and field lines on the field are detected(see Fig. 5).
2. We set a robot in global locations of the field, and make a lookup table of these intersections before the game.
3. Robot's location in the field is estimated by calculating the likelihood in the Particle filter algorithm from the lookup table.

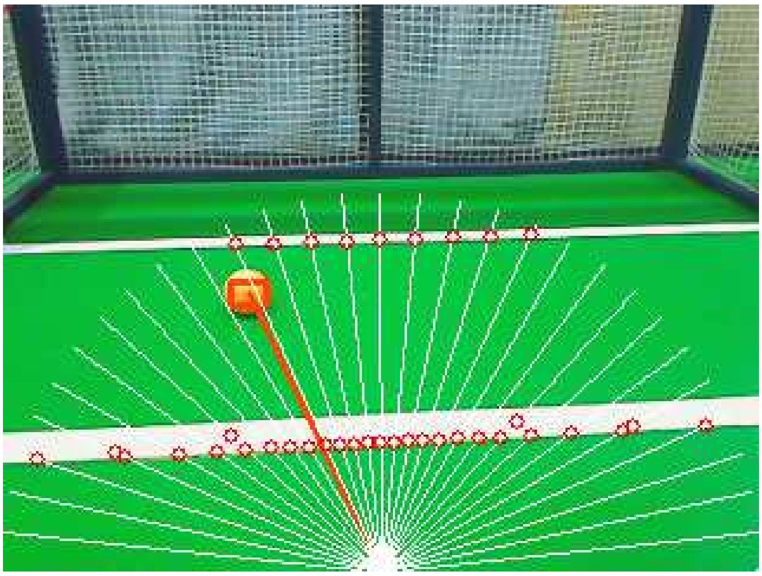


Fig. 5. Detecting field line

5 Conclusion

We have described the hardware and software features of our robot to be used for the competition in Istanbul. This year is the first participation of our team, but we focus on development of self-localization system to enable the robot to get better performance.

References

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