FIBOT – Extended Abstract for RoboCup 2023 Humanoid Soccer Competition KidSize

Piamsuk Noipong[1] ,Wisanu Jutharee[1], Teerameth Rassameecharoenchai [1], Chayanut Rassameecharoenchai [1], Pannatorn Bongkotamphon [1], Natanan Tirasukvongsa [1], Russapat Leelawattanakiet [1] , Jitphisuit Thanajinda [1] , Tinn Pongjitumpai [1] , Bantoon Srisuwan[1][0000-0001-8156-3611]

[1] Institute of Field Robotics (FIBO), King Mongkut's University of Technology Thonburi (KMUTT), Bangkok, Thailand
information@fibo.kmutt.ac.th
http://www.fibo.kmutt.ac.th/humanoid/

Abstract. In this paper, we will cover it in four sections. In the first section, we will cover the lessons learned from the previous competition. Secondly, we will explain what needs to be solved and improved in the next tournament. Moreover, we will describe the improvement plans for RoboCup 2023. Finally, we will show plans for future work before the beginning of RoboCup2023.

1 Lessons Learned from Previous RoboCup Competitions

In the RoboCup 2022, we encountered many unexpected problems. First, the structure of the robot was not strong enough which was caused by most of the robot's parts being made by the folding process. As a result, the components subjected to heavy load were bent. Second, our communication via the WIFI network is not effective enough, sometimes unable to communicate with the control box. Moreover, the localized system was mostly tested in visual and specific environments, and when we port to the robot for running in competition, it cannot operate as we anticipated. However, we decided to improve the hardware, change the modeling procedure, and apply a particle filter to the localized system.

2 Solving Major Problems

In this tournament, we will improve the robot's software and design. In the coming competition, we are going to improve the robot's structural strength, especially, in the thigh joint and leg area. We will apply 2 angular contact bearings between the robot's leg and Dynamixel to support torque. Moreover, we are going to apply H structural to strengthen the robot's arm and leg. Finally, before modeled, we will simulate the force that applies to each part in an extreme event using the Solidwork application. Moreover, the body part will increase space to upgrade computational hardware to Jetson Xavier

NX and Nucleo-G431KB. For localization system, we will implement particle filter and Inverse Perspective Mapping to improve the localization.

3 The Improvement Plans for RoboCup 2023 Competition

In the localization section, A particle filter will be used to improve the localization of the robot's position. We will detect the field line in the image from the camera and convert it to the relative points. Therefore, the points used to be the reference with the map. They are estimated distance by Inverse Perspective Mapping (IPM). In addition, we planned to implement sensor fusion to improve localization efficiency.

In the robotic movement section, the distance between the robot and the ball is determinable after we receive the ball and the robot's position. After that, inverse kinematics will apply in each walking step. The inverse kinematics give the angle value in each joint. The angle value is an input of cascade control which assigned the maximum acceleration and velocity for current control on Dynamixel.

We use Nucleo-G431KB as a low-level control device because of its performance in mathematical calculation. The structure of the low-level system will be separated into each body part. For Instance, each of the robot's legs will be separately controlled by one Nucleo. Therefore, the control system will be run as real-time as possible. In addition, we will use the tool named "Xicro", a package on ROS2. It can transmit data between ROS2 and Nucleo without using RTOS, and we can perform tasks and use the resources on the microcontroller efficiently.

4 Implementation Status

Table 1. Gantt Chart

Task	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
Robot Design (e.g., PCB Modelling)							
Walking (e.g., Inverse Kinematics)							
Software (e.g., Vision SLAM Decision)							
System Integration							
Competition							

References

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