Ichiro ITS Team - Extended abstract
Humanoid Kid-Size League, RoboCup 2024 Eindhoven

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Abstract: This extended abstract based on our experience in RoboCup in 2022. We learned some valuable lessons from the last competition, so that we can develop some new features in electrical hardware and improve the robot's walk-control. We also designed a new mechanical robot’s legs and hands, which is currently under construction and testing.

Keywords: develop, hardware, walk-control, mechanical.

1 History and Overview

Team Ichiro is a robot team from the Sepuluh Nopember Institute of Technology Surabaya, Indonesia. We specifically conduct research in the development of humanoid robots and participate in various humanoid robot competitions. In 2023, we developed our robot by emphasizing the development of reliable mechanical designs and our vision algorithms, which allow the robots to localize themselves in the field using our vision and odometry systems. We keep evaluating several things that can be developed from the problems and shortcomings of our robot during the previous RoboCup competition.

2 Developments

2.1 Sub-Controller Board

We develop a new board for interfacing servo control, an IMU sensor, and some LED and Interrupt Button to replace CM-740, our old sub-controller. We’ve just replaced the old Sub-Controller (CM-740) with our new ichiro dxl board controller to manage and control the Motor Servos and IMU sensors for the orientation. The USB to TTL / RS-485 we used is FT4232H Mini Module to communicate between Main Controller and Slave, such as Motor Servos and Microcontroller using TTL or RS-485 communication. For the IMU Sensor we used the BNO055 module from Bosch to obtain an orientation value. But for orientation calculation we just pick accelerometer and gyroscope value to obtain orientation (Yaw angles) value.

2.2 Mechanical Design

From the RoboCup 2022 competition in Bangkok, we identified several aspects that need modification and improvement. After reviewing the CIT Brains team and engaging in discussions, we realized that the robot impact protector we created is less effective and challenging to manufacture. We have begun to modify the design and material, transitioning from the previous use of 5mm Aluminum bar to TPU filament material. We have also added impact protectors on the right and left sides of the robot using softer TPU material to minimize damage to the robot. Another improvement is that we also change the materials for the robot part. Last year our robot used 3mm thick type 5 Aluminium. But, the type 5 of aluminium is quite heavy and can't hold the impact while the robot is falling. Due to that problem, we decided to change the material of the body material with 3 mm thick carbon fiber which has more durability and lighter than aluminium. We also use the PLA+ and PETG 3D printed filament for minor parts in order to reduce the weight of the robots.

2.3 Program Framework and Robot Behavior

Our robot's program was built on a monolithic framework using object-oriented principles that contains all of our projects in a single container. Although it seems simpler to develop, it becomes harder to maintain as the program scales bigger. When research is being done, the whole codebase needs to be rebuilt. We are currently working on migrating the program into a ROS2-based codebase. The old program is split into smaller parts as ROS 2 packages based on functionality like vision package, action package, mathematical operations custom package, and so on. Each package operates as a microservice that provides services needed by the main soccer program. Thus, when research is being done on a particular package, it doesn't affect the other packages.

In previous years Robocup, our robot also frequently failed to execute a kick when a disturbance was received. To prevent this, we are implementing spline interpolation for better motion execution. The program treats the poses as keyframes and uses the keyframe points to control the speed of the motion so the execution of the motion will be smoother. Our robots also find it difficult with the localization, or the ability to determine its position based on the environment it detects. Specifically, after the robot is picked up from the field, and must be released at a random point. Currently, we are working on using image perspective mapping to calculate the real-world distance between the robot and the field features more accurately so the robot can find its position in any position of the field.

References

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