Robocup 2020 - Extended abstract Team ZSTT-NTNU

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Abstract. We describe 4 parts in this paper. First, we explain our lessons learned from the participation in the previous competition. Second, this paper shows our problems to solve for the upcoming competition. Third, we present our plans of major changes the teams anticipates to have implemented by the Robocup 2020. Finally, we describe the status of implementation about the design, hardware, and software.

Keywords: Robocup Adult-size · ZSTT-NTNU · Intelligent Humanoid.

1 Extended Abstract

Team ZSTT-NTNU have been participating in the adult-size Robocup humanoid league since 2017. We need to develop a lot of things as a team that has only been in the Robocup for three years. Our robots are being improved every year by advice from other teams, asking many questions to other teams. Our improvements are as follows.

1: Hip yaw design
- We had the problem of connecting our legs directly to the horn of the hip yaw motor and breaking the bolts of the horn.[*2017*]
- We improved the problem of breaking the horn by using external gears and thrust bearings on the Hip yaw motors. (*Huroevoloution and Nimbro*)[*2018*]

2: Spur gear design
- When we designed extra spur gears, there was a problem with the backlash.[*2018*]
- A member of the *Nimbro* team taught how to design the distance between spur gears, we built the minimizing backlash. (*Nimbro*)[*2019*]

3: Hip yaw design 2
- When we designed extra gears, thrust bearings, and 8mm bolts on the hip yaw motors, the backlash of the front, back, left and right of the leg was large.[*2019*]

- Prof.Jeakweon Han and Minho Seo of *HERoEHS* team suggested bearings such as an angular contact roller bearing and a cross roller bearing.(*HERoEHS*)

We have problems of the design and software despite the help of other teams. We have the design problem of the hip yaw motors, so we continue to improve the design of the hip yaw for the minimizing backlash. We use hough circle to find the ball. But hough circle algorithm cannot find the ball if the ball is too far. If the opponents or the handler have circle like shapes on their body, our system might recognize it as the ball instead of the real ball. In localization, many teams use fast SLAM. However, we need many land marks and particles for correct position. If we use many land marks, the software system is vesy slow.

Our team aims to develop a robot that is cheap and easy to use. We are developing how to use light systems(embedded boards, low cost intel cores) and deep learning acceleration modules such as NCS2 or Google Coral for Robocup. For better localization, we will use Intel real sense T265. it has 0.1m error per 10m.

We are comparing performance of some platforms as follows.

1: Device
  - Jetson Nano
  - Jetson Nano with coral
  - Jetson Nano with NCS2
  - Tablet(Intel core m5) with coral
  - Tablet(Intel core m5) with NCS2

2: Deep learning algorithms
  - Resnet
  - Movilenet
  - Tiny yolo
  - Unet
  - VGG-19

Our humanoid robots are a fully autonomous adult size humanoid, which is 1.35m tall and weighs 12kg. It is constructed with 20 degrees-of-freedom. The omni-directional walking gait of the humanoid is implemented based on parameterized motions using the inverse kinematics of the robot and is able to balance using IMU feedback. The software is implemented with python and using OpenCV for the robot's object detection and localization. Our system detects the ball and opponents as well as field lines and goal posts for localization [1].

References

1. Jeong, J., Yang, J., Kim, H., Baltes, J.: RoboCup 2019 - TDP Team ZSTT. https://www.robocuphumanoid.org/hl-2019/teams/. Accessed 2019-12-03