



## Robot Specification

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- Robot name: ALICE (3<sup>rd</sup> version)
- Degrees of freedom : 24 DOF [ Leg(12), Arm(8), Head(2), Waist(2) ]
- Height of robot: 137 cm
- Weight of robot: 24 kg
- Waking speed:
  - Forward and Backward: 0.38 m/s(max.)
  - Turning to the left and right: 0.3 rad/s(max.)
- Type of motors: Robotis Dynamixel PH54-100-S500, PH42-020-S300 and XH-540
- Type of sensors: ZED stereo camera, LORD IMU sensor and Robotus FT sensors
- Computing unit (s): NVIDIA Xavier AGX and Intel NUC(i5)



## Appendix A. The History of ALICE Series

ALICE is an Artificial Learning Intelligent robot for Culture and Entertainment. ALICE has been developed since 2018. It was designed as a female-type robot. We did this to make users feel comfortable when they encounter the robot. As a result, ALICE is made as a human-friendly robot. ALICE1 participated in the RoboCup 2018 in Montreal, Canada. This robot can recognize a soccer ball through CNN. The walking speed of this robot is about 0.02 m/sec. It has a foot structure suitable for dribbling and has implemented a simple strategy of performing only forward movement.

ALICE2 participated in the RoboCup 2019 in Sydney, Australia. The robot used Dynamixel Pro to significantly improve hardware specifications, resulting in a walking speed of 0.25 m/sec and a rotational speed of 0.3 rad/sec. A front kick may be performed, and a side kick may be used to get out of a deadlock.

ALICE3 was developed in 2020, but the RoboCup 2020 was not held due to the Covid-19 issue. The robot added yaw and pitch joints to its waist so that it can stand up when it falls, rotate its waist, and search widely. The robot's ROM(Range Of Motion) was expanded by designing the leg in a bent shape. We participated in Virtual RoboCup 2021 with this reflected.

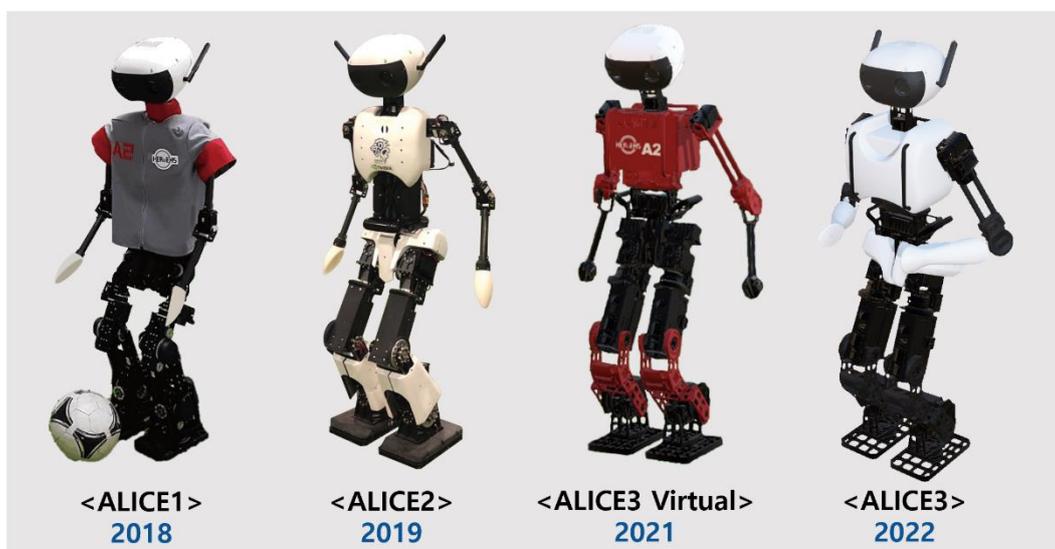


Figure 1. The History of ALICE Series

**Appendix B. Mechanical Design**

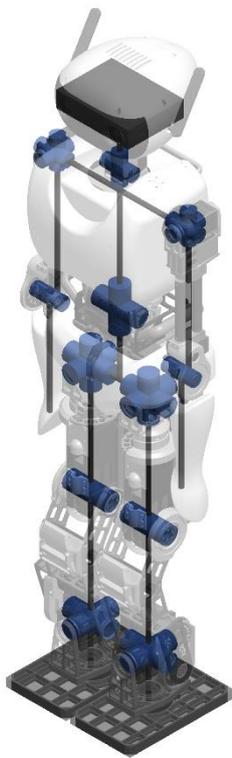


Figure 2. The ALICE 3's Kinematics Diagram

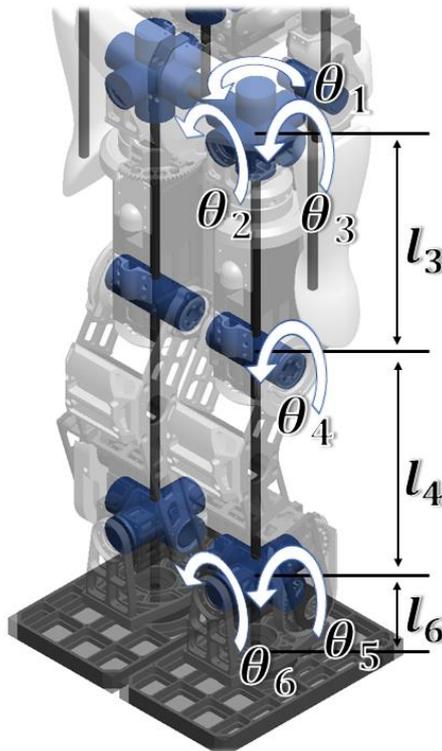


Figure 3. The ALICE 3's Leg Structure

Table 1. Configuration of Actuator

	DoF	Control Interface	Model
Torso	2	Position, Current	ROBOTIS(c) PH54-100-S500-R, XH540-V270-R
Arms	4*2	Position, Current	ROBOTIS(c) PH42-020-S300-R, XH540-V270-R
Neck	2	Position	ROBOTIS(c) XH540-V270-R
Legs	6*2	Position, Current	ROBOTIS(c) PH54-100-S500-R, XH540-V270-R

Table 2. DH Parameter

	$\theta_i$	$\alpha_i$	$a_i$	$d_i$
1	$\theta_1$	$\pi/2$	0	0
2	$\theta_2 + \pi/2$	$-\pi/2$	0	0
3	$\theta_3 - \pi/2$	$-\pi/2$	$l_3$	0
4	$\theta_4 + \pi/2$	0	$l_4$	0
5	$\theta_5$	$\pi/2$	0	0
6	$\theta_6$	0	$l_6$	0