

ROBOT FOR COEXISTENCE AND COOPERATION



**RAINBOW
ROBOTICS**

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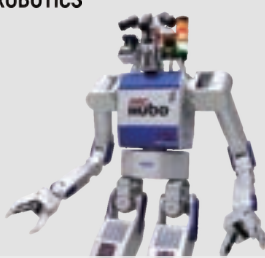
- 01 Collaborative Robot RB Series
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■ HUBO, Korea's first humanoid robot

A humanoid robot is the highest-level robotic platform of its kind, built on all existing advanced robotic technologies. It is considered the ultimate form of robot that humanity has ever dreamed of.

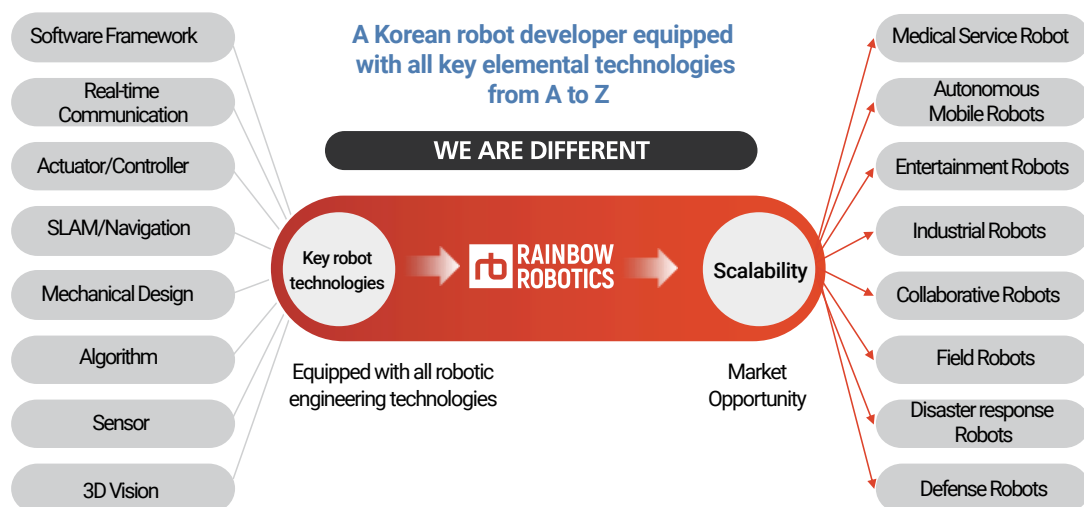
what is a robot? : It is a machine device that is capable of moving on its own and sensing and manipulating objects, or a machine that features any of such functions.

Major Humanoid Robot Developers and Models

 Developer Honda Model Name ASIMO The world's first two-legged humanoid About 40 years of continuous research experience in two-legged robots	 Developer Rainbow Robotics Model Name DRC-HUBO Korea's one and only two-legged humanoid Spin-off from KAIST	 Developer Boston Dynamics Model Name Atlas Spin-off from MIT Purchased by Google (2013), Purchased by Softbank (2017), and then purchased by Hyundai Motor Company (2020)
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■ Rainbow Robotics, one of Korea's leading robot developers

As one of the world's leading players in robotics, Rainbow Robotics has been driving Korea's robot industry. Rainbow Robotics has continuously developed and acquired key robot technologies through extensive humanoid robot development activities, demonstrating that it has a great potential for future growth.





Chapter 1

Introduction to Rainbow Robotics

01 Overview

02 Key Human Resources

03 Company History

04 Core Technological Competencies

05 Breakthrough Systems & Platforms Developed for the First Time in Korea

06 Successful Breakthrough Technologies (high-precision pointing mount systems)

Overview

A tech company equipped with key robot platform technologies, which started out as a spin-off from KAIST, Korea's engineering technology hub

General Status

Company name	Rainbow Robotics Co., Ltd.
CEO	Lee, Jungho
Date of establishment	February 10, 2011
Field of business	Special-purpose machine manufacturing
Major business fields	Collaborative robots, telescope mount systems, two-legged robots, etc.
Location of the head office	10-19, Expo-ro 339beon-gil, Yuseong-gu, Daejeon, Repulic of Korea
Official webpage	www.rainbow-robotics.com

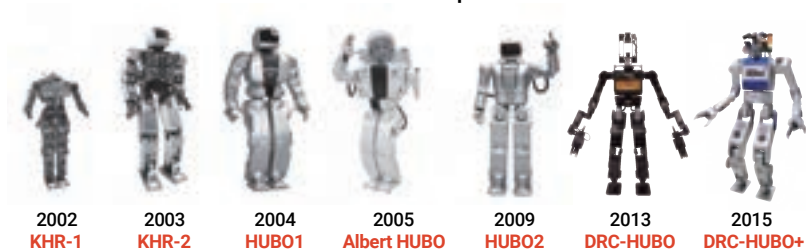
Establishment Background



Best Robot Company in Korea

Equipped with key robot technologies,
which are among the most advanced in Korea

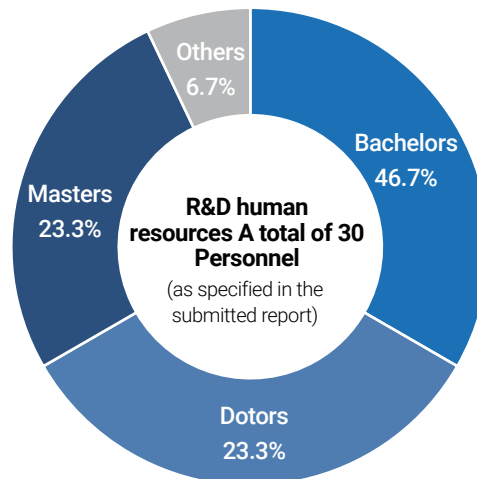
Milestones in the development of HUBO



■ Key Human Resource

The best robotics experts in Korea

R&D human resources



Key Member



FOUNDER, CTO

Oh, Jun-ho

- Professor of Mechanical Engineering at KAIST
- Received a Doctoral Degree in mechanical engineering from UC Berkeley, USA
- Director of the Humanoid Robot Research Center at KAIST
- Received the 26th Ho-Am Prize in Engineering (2016)



CEO

Lee, Jungho

- Received a Doctoral Degree in Engineering from KAIST
- Korea Institute of Robot and Convergence
- Institute of Industrial Technology, Samsung Heavy Industries

[Acquired technologies]

- Real-time operating system
- Robot operating software
- System integration technology



General Director of Technology

Heo, Jung-woo

- Received a Doctoral Degree in Engineering from KAIST

- Two-legged walking algorithm
- Robot motion generation algorithm
- Instrument design and control algorithm



General Director of Technology

Lim, Jeong-soo

- Received a Doctoral Degree in Engineering from KAIST

- Real-time control
- Robot motion generation algorithm
- System integration technology



Principal Research Engineer

Bae, Hyo-in

- Received a Doctoral Degree in Engineering from KAIST

- Structural design for robot operating software
- Robot system design and control



Principal Research Engineer

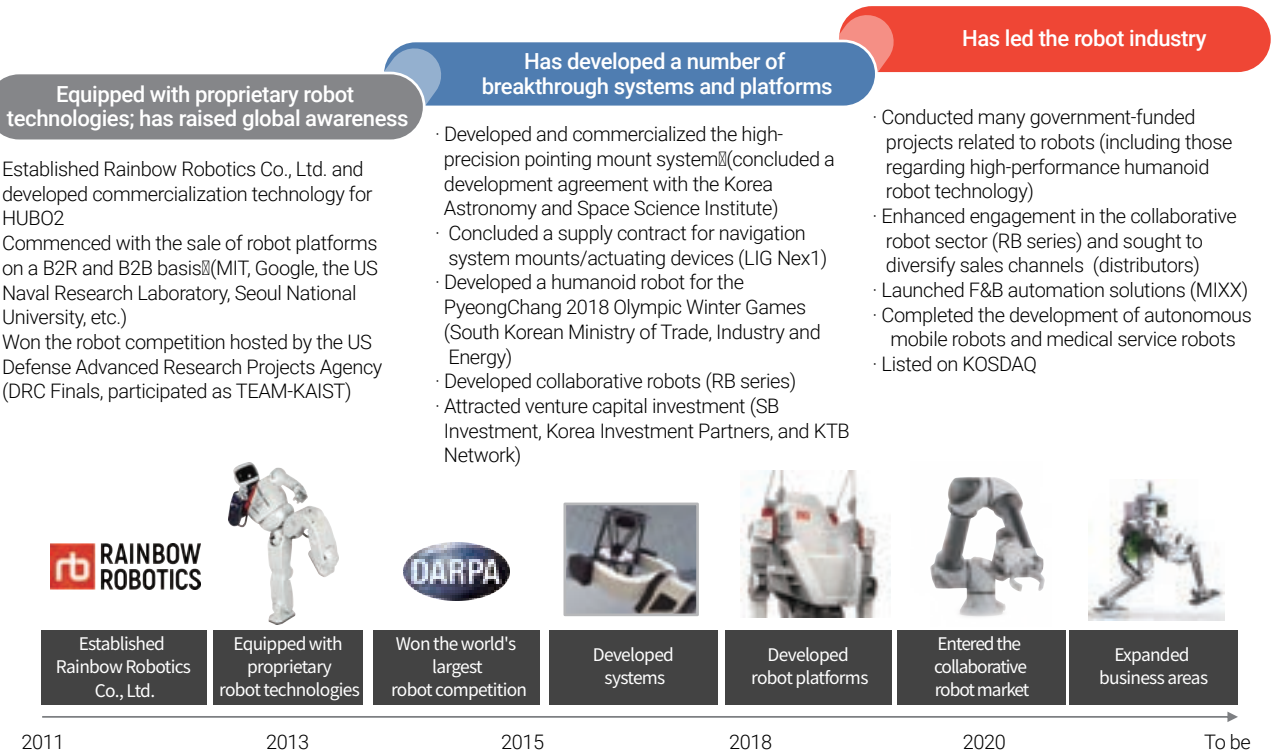
Jeong, Hyobin

- Received a Doctoral Degree in Engineering from KAIST

- Wholebody Dynamics based Control Algorithm for legged robot
- Legged robot hardware design

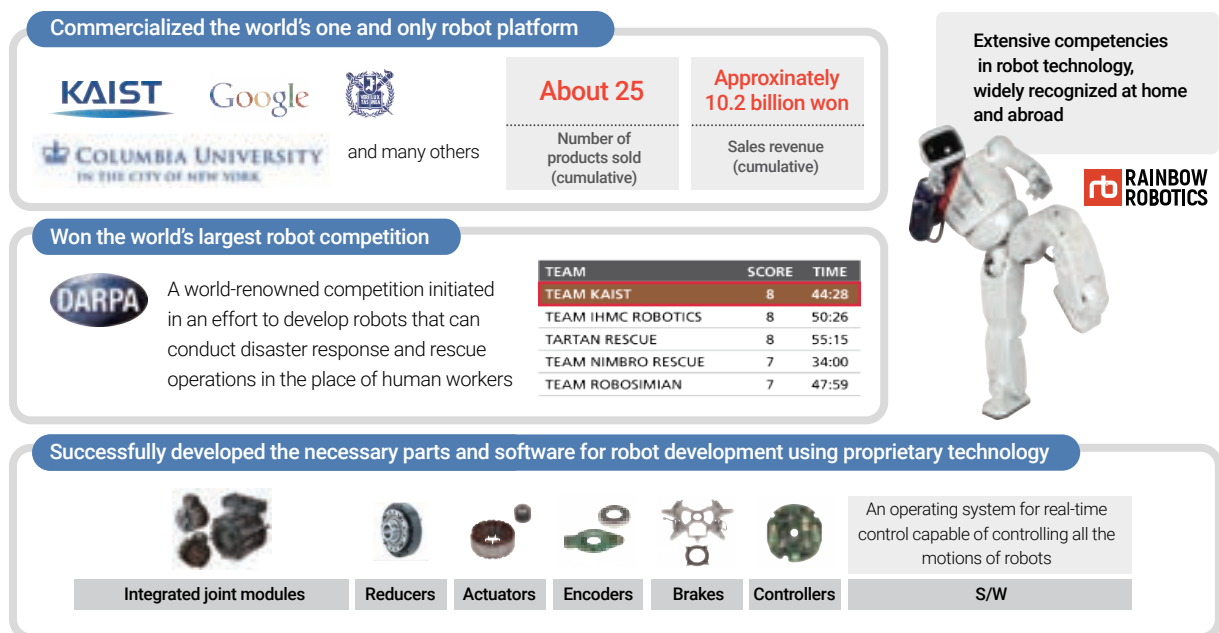
Company History

Spearheading Korea's robot industry based on its unique, unparalleled key robot technologies



Core Technological Competencies

Has acquired and advanced proprietary key robot technologies



■ Breakthrough Systems & Platforms Developed for the First Time in Korea

Has developed and supplied different breakthrough products for the first time and as the only provider in Korea using its extensive elemental technologies in robotics

Two-legged/four-legged robot platforms

HUBO2



The best humanoid robot in Korea

DRC-HUBO



The world's best disaster rescue robot

Four-legged walking robot



Four-legged walking robot under development

Robot platform technology (collaborative robots, beverage robots, etc.)

RB Series



A collaborative robot

Beverage -making robots, MiXX



Collaboration with the collaborative robot RB Series

High-precision pointing mount systems

Large-scale fork-type mounts for observatories



Professional mounts for fixed observations



The only astronomical mount systems in Korea

Core robot components (controllers, sensors, etc.)



Applied to the development of Solaris by Hyundai Motor Group

Autonomous mobile robot platforms



Mobile Platform JAY

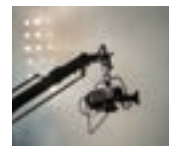


A Mobile robot

Broadcasting systems



5-axis ultra-close-up shooting equipment



2-axis automatic crane-based stage equipment



6-axis Stewart platform-based stage equipment

Source: Images from public broadcasting stations

Successful Breakthrough Technologies (high-precision pointing mount systems)



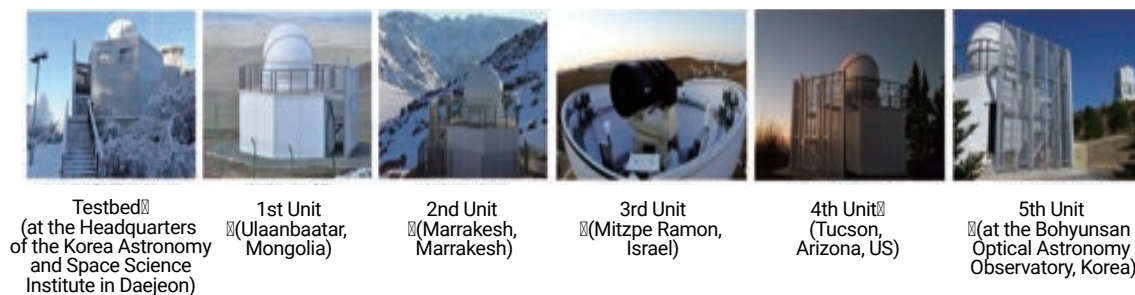
Specific technologies related to the mount system

Application of ultra-precision pointing technology

High-precision control technology required to enable the precise tracking and monitoring of distant objects



Continues to expand its market share in the astronomical sector
(accounting for about 70% of the domestic procurement market)



Expands its business scope to cover the defense industry





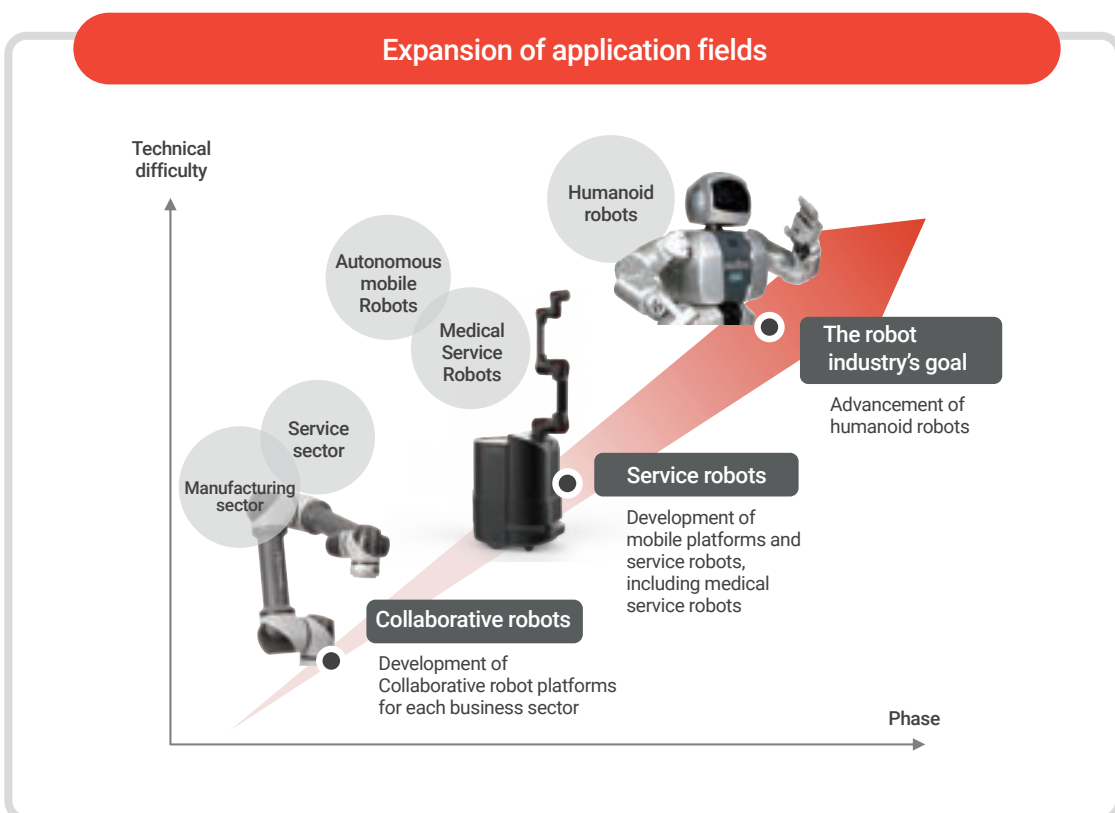
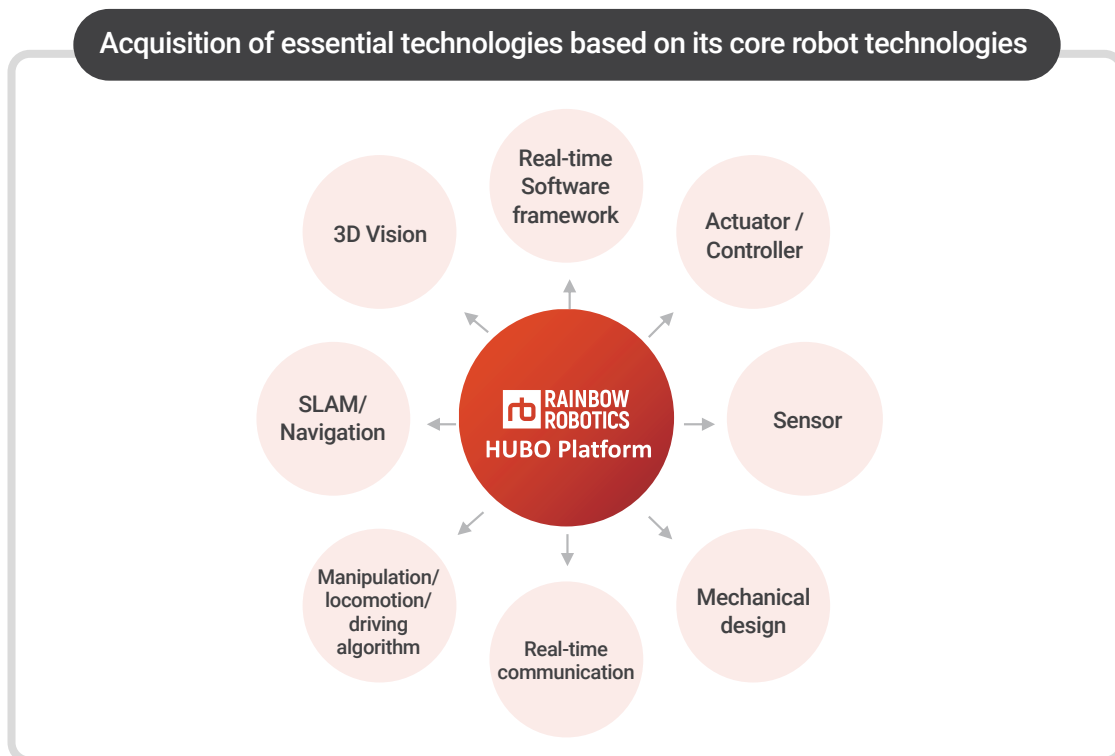
Chapter 2

Growth Momentum

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- 06 Differentiated Product Competitiveness
- 07 Cases of RB series applications

■ Business Expansion Strategy

Has expanded its scope to cover many different areas and bring innovation based on its core technologies and expertise in robotics



■ Collaborative robots, Increasingly at the Center of Attention in the Robot Industry

The range of collaborative robot applications has expanded from the manufacturing sector to various service industries

Paradigm shift

Changes in manufacturing methods for increased productivity

Increased demand for alternatives to human labor due to population aging, population reduction, and the introduction of the 52-hour work week

Advent of the digital transformation (DT) era

Increased inter-industry breakthrough technology flows based on technology convergence via 5G and the Cloud

Environment changes in the COVID-19 era

Increased application of automated solutions to respond to changes in the non-contact era and a shift toward unmanned operations

Expanded application range and market size of collaborative robots

Increasing productivity per capita

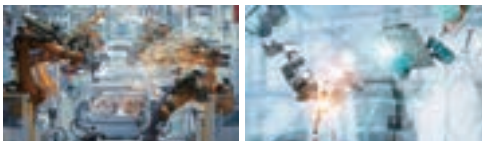
Safe enough to work with human workers

Easy to operate and install



Application range

Production and manufacturing sectors

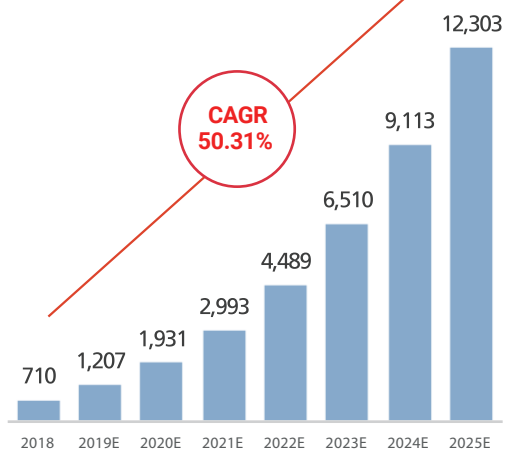


Service sectors



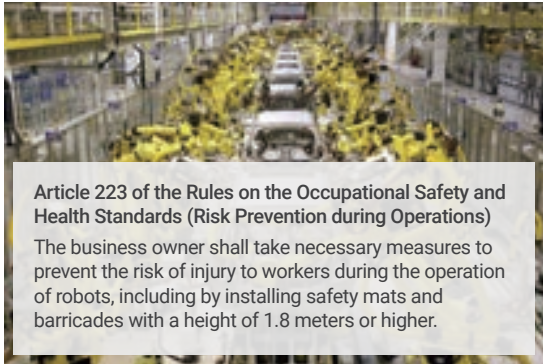
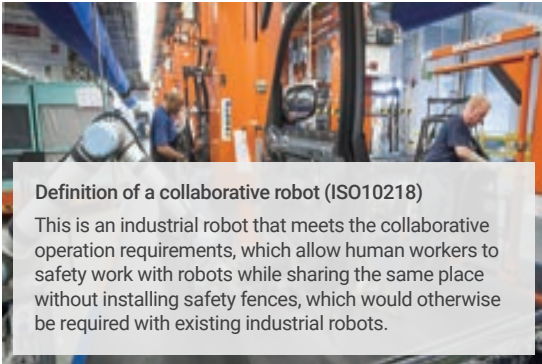
Market size

Unit: USD Million



Reasons for Inevitable Growth in Collaborative Robots

The robot industry has been reshaped to focus more on collaborative robots, rather than on industrial robots.

Traditional industrial robots	VS	Collaborative robots
 Article 223 of the Rules on the Occupational Safety and Health Standards (Risk Prevention during Operations) The business owner shall take necessary measures to prevent the risk of injury to workers during the operation of robots, including by installing safety mats and barricades with a height of 1.8 meters or higher.		 Definition of a collaborative robot (ISO10218) This is an industrial robot that meets the collaborative operation requirements, which allow human workers to safely work with robots while sharing the same place without installing safety fences, which would otherwise be required with existing industrial robots.

Reasons for inevitably choosing collaborative robots over industrial robots

Lower acquisition costs compared to existing industrial robots

Easy to operate and manage

Enhanced safety of workers

Flexible arrangement and improved productivity

The range of applications has extended to manufacturing SMEs and a wide variety of service industries.

Source : Robot Newspaper (2017.07.04)

Various Business Opportunities in the Collaborative Robot Market

The range of collaborative robot applications now extends to cover non-contact services, unmanned automation systems, etc.

Production, manufacturing and education service robots



Welding robots

Machining robots



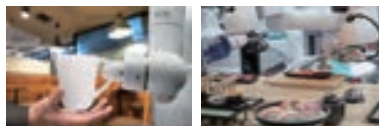
CNC robots

Laser marking robots



Education and hands-on training robots

Food and beverage service robots



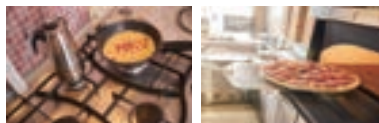
Coffee-making robots

Cooking robots



Ice cream making

Beverage making



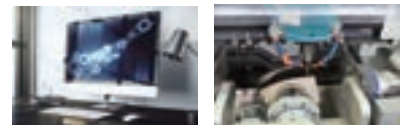
Omelet-making robots

Pizza-making robots

Various service areas



Logistics robots



Desktop robots

Glasses frame making



Systems for preventive measures

Robotic studios

■ Enhanced Engagement in Collaborative Robot Business

Has developed major key components based on proprietary technology and completed the development of collaborative robot products using essential technologies

Launched the collaborative robot RB Series

2018

Conducted R&D
on collaborative robots

2019

Completed product development
within only 16 months

2020

Participated in a wide range
of demonstration projects

From 2020 onwards

Has engaged more
in the sales of the products



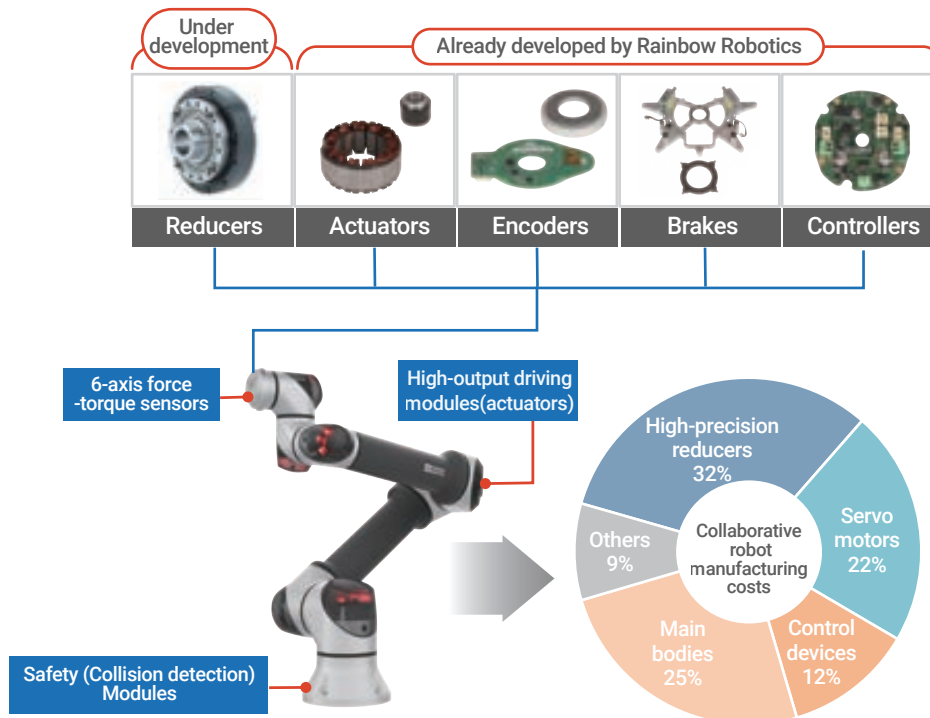
Differentiated Product Competitiveness

Equipped with differentiated competitiveness amid many companies competing to increase their dominance in the collaborative robot market

Rainbow Robotics' technologies

Division	A company	B company	C company	D company	
Reducers	X	X	X	X	X Under development
Actuators	X	X	X	X	O
Encoders	X	X	X	X	O
Brakes	O	O	X	X	O
Controllers	O	X	X	X	O
Software	X	X	X	X	O

Note : Estimated by Rainbow Robotics



Developing optimum products for each client while seeking performance improvement

Unparalleled price competitiveness and excellent customer services

■ Cases of RB series applications

1 CNC machine tending

CNC machine tending is a process that repeats the task of inserting raw materials into a machining tool, then taking out the processed product. RB series not only performs simple and repetitive tasks on behalf of human workers, but also prevents the risk of industrial accidents. Furthermore, it supports IP66-rated (dust and water-resistant), meaning RB series can continue to work without any issues even if it comes in contact with cutting oil and coolant during the machining process.



STS PRECISION CO., LTD

"We have managed to boost productivity by 40~50% by introducing RB series cobots to the manual CNC process. Also, we are now able to respond more actively to the demands of our customers, which have increased two to three times since the recent boom in semiconductors."

2 Mold handling

Mold handling is used when loading-unloading injection molded parts. A cobot can perform dangerous tasks such as operators putting their hand into the injection molding machine to take out a newly produced component.



TP Solution

"Since a robot is always consistent in performing its task, it reduces the defect rate and boosts productivity quite substantially. Also, cobots can help workers learn new skills. For example, they can learn how to control the overall process, rather than performing simple and repetitive tasks."

3

Welding solutions

As standard, RB series is equipped with the necessary functions for weaving and arc welding, which makes it capable of various welding applications, including specimen, argon, weaving, pulse, arc, and corner welding.



J.system

"Welding requires great precision and attention to detail. Naturally, you need to input a lot of robot motions and points. Unlike industrial robots, cobots come with a direct teaching function, making motions and points much easier to input."



JCT

"Welding systems using cobots have the advantage of being easy to install and being capable of small-lot productions compared to conventional industrial robots. Also, cobots are more economical in terms of the space and cost they require since they do not require any additional devices or facilities such as fences. If you are finding it difficult to recruit an experienced and skilled welder, try using a robot welder that is easy to control, even for novice robot operators."

4

Milk tea barista robot

Milk tea barista robot is a beverage platform developed together by Rainbow Robotics and BOBA ROBO. The platform is equipped with AI robotics technology, so when a customer orders a drink using an unmanned kiosk, the platform can deliver the order within 95 seconds. Meanwhile, supervisors can check the order and waiting status using a dedicated monitor.



BOBA ROBO Inc.

"The world's first milk tea barista robot is available at the University of Nevada, Las Vegas in the United States. Milk tea barista robot is particularly popular among MZ generation consumers. It satisfies customers with more than just simple robot movements - it produces milk tea in a similar way a human barista would do to deliver delicious cups of milk tea. In Korea, the first BOBAROBO platform is available at the Oksan Service Station in Chungcheongbuk-do."

5

Ice cream robot

Ice cream robot using RB series is operated in collaboration with employees in the store. It provides high-quality ice cream regardless of employee proficiency.



GS Global

"We introduced an ice cream robot as a unique marketing initiative at our Cafe on the Road establishment at the Cardoc Gas Station in Ilsan. Ice cream robot is very popular with children and customers. Plus, our staff is extremely happy since the robot has helped take a simple and repetitive task off their hands. In particular, we were looking for a platform that was easy to use once it was installed. We made an inquiry to Rainbow Robotics, and we were able to get the technical support we needed."

01

Cobot that works with workers

RB Series



Rainbow Robotics' RB series is a 6-axis cobot developed by Rainbow Robotics using technology researched and developed in Korea. The RB series features multiple products (RB5-850, RB3-1200, and RB10-1300) to suit the user's work environment, and all products have the CE and KCs certifications approved by the global certification body TUV SUD.



RB series lineup

- RB5-850, RB3-1200, RB10-1300
- (Scheduled Release) RB3-630, RB16-900

Range of applications

- Packaging
- Welding
- Assembly
- Quality inspection
- Bonding/gluing, application
- Picking and placing
- Laser marking
- Weld Site UT
- Injection molding
- Photo and video shooting
- CNC machine tending
- 3D Scanning

Key Features

- Securing high levels of performance and great price competitiveness by internalizing the production of core components
- Cobot with built-in humanoid robotics technology
- Software to boost user's convenience

Built-in Pneumatics Option (A1, A2)

Model Name	Pneumatics line	Signal line
RB5-850A1	4 EA(4Ø tube)	N
RB5-850A2	4 EA(4Ø tube)	12 Pin(AWG28)
RB3-1200A1	4 EA(4Ø tube)	N
RB3-1200A2	4 EA(4Ø tube)	12 Pin(AWG28)
RB10-1300A1	1 EA(8Ø tube)	N
RB10-1300A2	1 EA(8Ø tube)	12 Pin(AWG28)

※ Specifications may change to improve performance.

※ In addition, when applying the option, it is necessary to check the driving range and operating environment.



Appendix

- 01 Collaborative Robot RB Series
- 02 RB-N Series
- 03 Astronomical Mounts
- 04 Quadruped robot RBQ-3, RBQ-5

World's first NSF-certified cobot RB-N Series



RB-N series has been certified by the National Sanitation Foundation (NSF) for safe and hygienic use in the food and beverages market, and is designed to be used as stand-alone units without the need to add any jackets or additional devices to the robot. RB-N series features three models, RB5-850N, RB3-1200N, and RB10-1300N, that can be applied in various food and beverage applications, such as fryers using high-temperature oil and espresso machines using high-pressure steam.



— RB-N series lineup

- RB5-850N, RB3-1200N, RB10-1300N

— Range of applications

- Unmanned cafe platforms
(Coffee, ade, milk tea, cocktail, etc)
- Soft ice cream robots
- Waffle-making robots
- Chicken-cooking robots
- Kitchen utensils-washing robots, etc

— Key Features

NSF Mark

- Safety certification for special purpose food processing equipment and related components (NSF/ANSI 169)
- Approved as a production facility/equipment by the NSF

Innocuous Cooking robot (safe for the human body)

- Uses special paint that does not emit any harmful substances
- Guarantees a level of safety that allows food to be cooked again even if it comes into direct contact with the robot
- Approved with a crash test (harmlessness of foreign substances such as paint chips generated as a result of a collision proven)

Use of highly durable fasteners/connections

- Uses special SUS fasteners/connections that do not rust
- Uses coupling rings proven for use at high temperatures and offers high strength, high stiffness, low moisture absorption, fatigue resistance, creep resistance, and great hygiene performance

Superior user's convenience

- Features a waterproof and dustproof 6-axis robot arm with an IP66 rating
- Works as a stand-alone robot unit that can eliminate the hassle of changing jackets and reduce costs

03

Astronomical observation equipment featuring high-precision robot control technology

Astronomical Mounts

An astronomical mount is an ultra-precise pointing device used when observing extraterrestrial space objects, such as planets, stars, and artificial satellites, from the ground. Rainbow Robotics developed an astronomical mount using humanoid robot technology. Unlike regular mounts, Rainbow Robotics' astronomical mount does not require any counterweights, which makes it much more portable.



— Astronomical Mounts lineup

- RST-135, RST-135E, RST-300

— Range of applications

- Movement observation
- Remote observatory
- Educational observatory
- Defense industry
- Satellite tracking, etc.

— Key Features

- Counterweights Not Required
- Lightweight
- Strain Wave Gear(Harmonic Drive)
- CNC Machining
- Wifi
- GPS Receiver
- Home Sensor

Quadruped robot developed using Korean technology

RBQ-3 | RBQ-5

RBQ-3 and RBQ-5 are quadruped robots capable of performing a wide variety of tasks. They are equipped with a battery of sensors, including LIDAR and cameras, so they can be used in various fields such as crime prevention (e.g. perimeter patrolling) and military applications.



— RBQ series lineup

- RBQ-3, RBQ-5

— Range of applications

-Military

Surveillance, reconnaissance, threat factor detection, etc.

-Fire safety

Search and identification of survivors and hazardous items, transportation of equipment through narrow passageways, etc.

-Safety inspection

Safety inspection of piping, narrow passageways, etc.

-Security patrol

Around-the-clock patrol, threat factor detection and notification

-User convenience

Convenience functions such as serving and guiding

-Logistics

Transportation of components within factories, last-mile logistics inside apartment complexes, etc.

— Product Specification (for RBQ-3)

Size : 400 x 600 x 500 mm

Weight : 25 kg

Payload : 3~5 kg

Operating hours : Max. 3 hours when fully charged

Speed : Max. 8 km/h

— Key Features

- Gait technology that allows the quadruped to navigate complex terrain
- Gait control algorithm that is highly resistant against external impacts
- Ability to execute dynamic motions such as backflips and jumps
- Up to 3 hours of continuous walking
- Sufficient payload to mount various sensors such as LIDAR and cameras



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