
RAINBOW
ROBOTICS

ROBOT FOR COEXISTENCE AND COOPERATION

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RAINBOW ROBOTICS

HUBO, Korea's first humanoid robot

RAINBOW ROBOTICS

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

RAINBOW ROBOTICS



- **Developer** Rainbow Robotics
- **Model Name** DRC-HUBO
- Korea's one and only two-legged humanoid
- Spin-off from KAIST

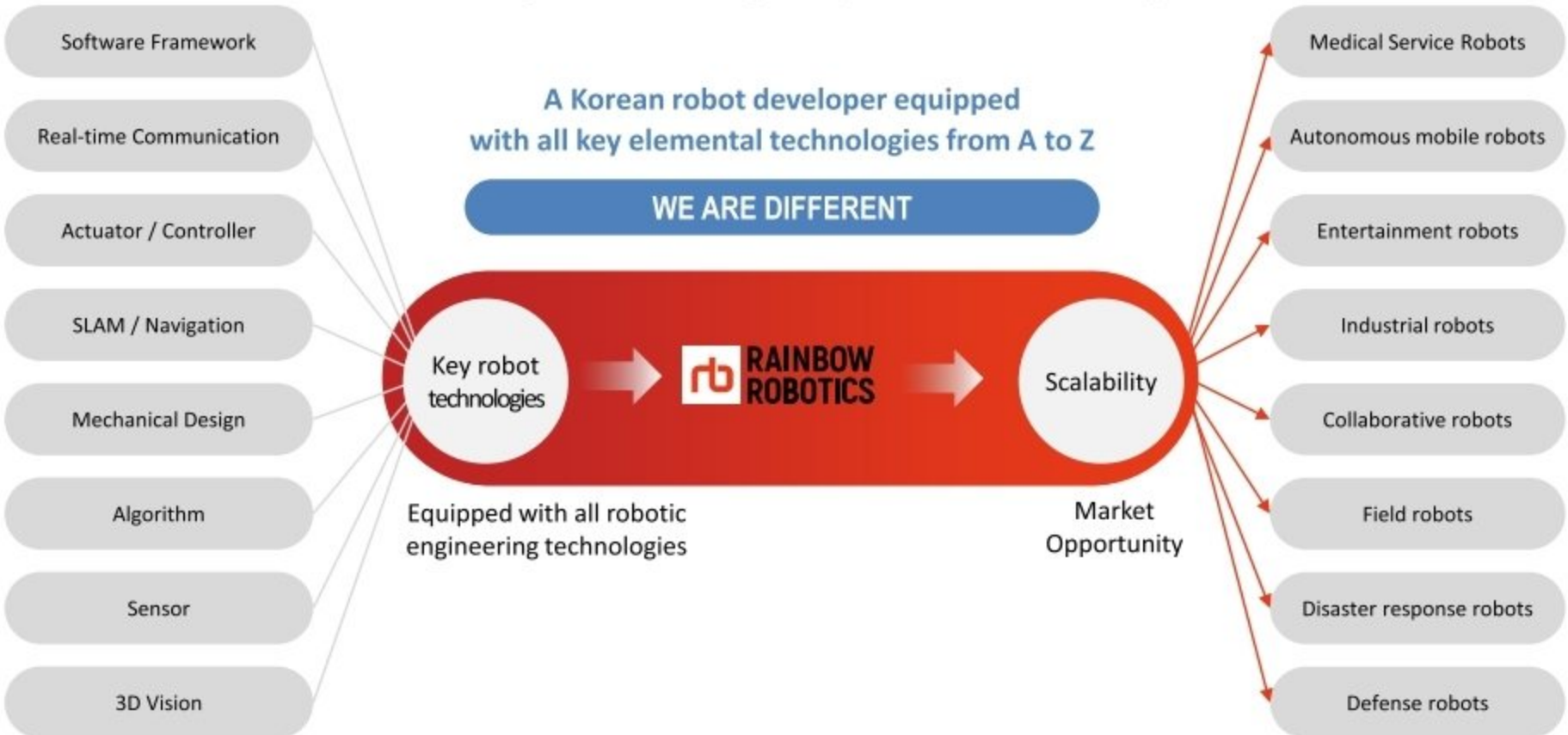


- **Developer** Boston Dynamics
- **Model Name** Atlas
- Spin-off from MIT
- Purchased by Google (2013), purchased by Softbank (2017), and then purchased by Hyundai Motor Company (2020)

Source: Each developer's official webpages

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.





ROBOT FOR COEXISTENCE AND COOPERATION

Robot for Artificial Intelligence aNd BOundless Walking

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

RAINBOW ROBOTICS

01. 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

KAIST — Best Engineering & Technology University in Korea

HUBO LAB Humanoid Robot Research Center — Best Robotics Research Center in Korea

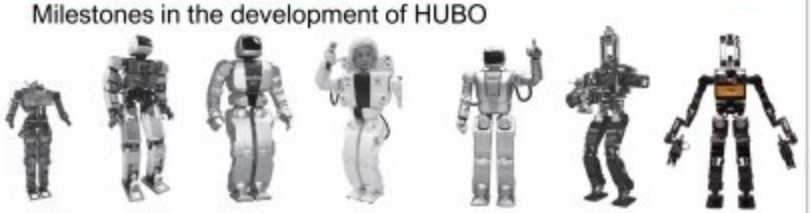
RAINBOW ROBOTICS

Spun off from HUBO LAB at KAIST in 2011

Best Robot Company in Korea

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

Milestones in the development of HUBO



Source: submitted securities report

02. Key Human Resources

RAINBOW ROBOTICS

The best robotics experts in Korea

Key talent



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

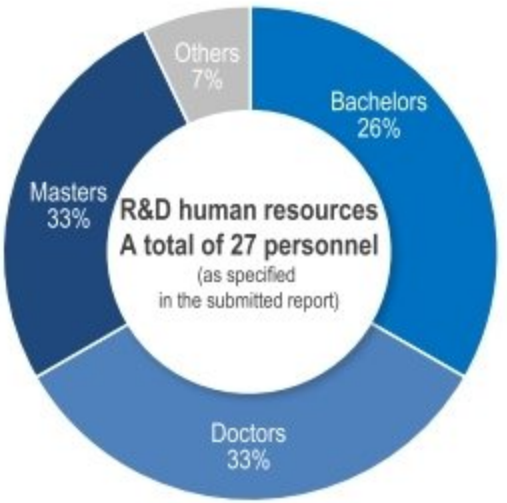


CTO

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)

R&D human resources





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

03. Company History

RAINBOW ROBOTICS

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

Equipped with proprietary robot technologies; has raised global awareness

- Established Rainbow Robotics Co., Ltd. and developed commercialization technology for HUBO2
- Commenced with the sale of robot platforms on a B2R and B2B basis (MIT, Google, the US Naval Research Laboratory, Seoul National University, etc.)
- Won the robot competition hosted by the US Defense Advanced Research Projects Agency (DRC Finals, participated as TEAM-KAIST)

Has developed a number of breakthrough systems and platforms

- Developed and commercialized the high-precision pointing mount system (concluded a development agreement with the Korea Astronomy and Space Science Institute)
- Concluded a supply contract for navigation system mounts/actuating devices (LIG Nex1)
- Developed a humanoid robot for the PyeongChang 2018 Olympic Winter Games (South Korean Ministry of Trade, Industry and Energy)
- Developed collaborative robots (RB series)
- Attracted venture capital investment (SBI Investment, Korea Investment Partners, and KTB Network)

Has led the robot industry

- Conducted many government-funded projects related to robots (including those regarding high-performance humanoid robot technology)
- Enhanced engagement in the collaborative robot sector (RB series) and sought to diversify sales channels (distributors)
- Launched F&B automation solutions (MIXX)
- Completed the development of autonomous mobile robots and medical service robots
- To be listed on KOSDAQ

RAINBOW ROBOTICS



DARPA









Established Rainbow Robotics Co., Ltd.	Equipped with proprietary robot technologies	Won the world's largest robot competition	Developed systems	Developed robot platforms	Entered the collaborative robot market	Expanded business areas
2011	2013	2015	2018	2020	To be	

04. Core Technological Competencies

RAINBOW ROBOTICS

Has acquired and advanced proprietary key robot technologies

Extensive competencies in robot technology, widely recognized at home and abroad

RAINBOW ROBOTICS



Commercialized the world's one and only robot platform

KAIST Google

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

and many others

About 25	Approximately 10.2 billion won
Number of products sold (cumulative)	Sales revenue (cumulative)

Won the world's largest robot competition

DARPA

A world-renowned competition initiated in an effort to develop robots that can conduct disaster response and rescue operations in the place of human workers

TEAM	SCORE	TIME
TEAM KAIST	8	44:28
TEAM IHMC ROBOTICS	8	50:26
TARTAN RESCUE	8	55:15
TEAM NIMBRO RESCUE	7	34:00
TEAM ROBOSIMIAN	7	47:59

Successfully developed the necessary parts and software for robot development using proprietary technology



Integrated joint modules



Reducers



Actuators



Encoders



Brakes



Controllers

An operating system for real-time control capable of controlling all the motions of robots

S/W

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

RAINBOW ROBOTICS

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

HUBO 2	DRC - HUBO	Four-legged walking robot
		
The best humanoid robot in Korea	The world's best disaster rescue robot	Four-legged walking robot under development

High-precision pointing mount systems

Large-scale fork-type mounts for observatories	Professional mounts for fixed observations
	

The only astronomical mount systems in Korea

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

RB Series	Beverage-making robots
	
A collaborative robot	Collaboration with the collaborative robot RB series

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



CHAPTER 2.

Growth Momentum

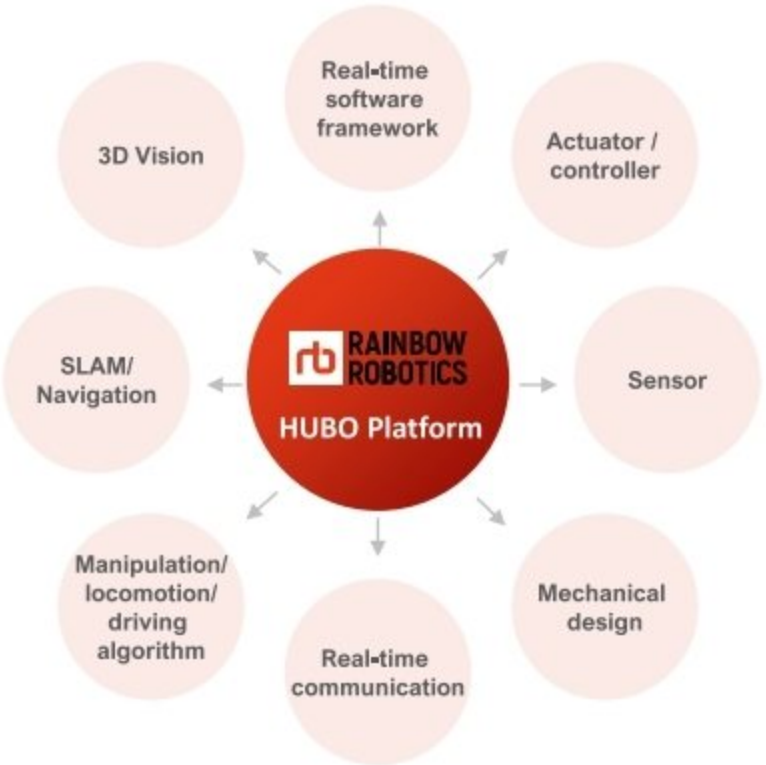
01 Business Expansion Strategy
02 Collaborative Robots, Increasingly at the Center of Attention in the Robot Industry
03 Reasons for Inevitable Growth in Collaborative Robots
04 Various Business Opportunities in the Collaborative Robot Market
05 Enhanced Engagement in Collaborative Robot Business
06 Differentiated Product Competitiveness
07 Generation of New Markets in Various Areas

RAINBOW ROBOTICS

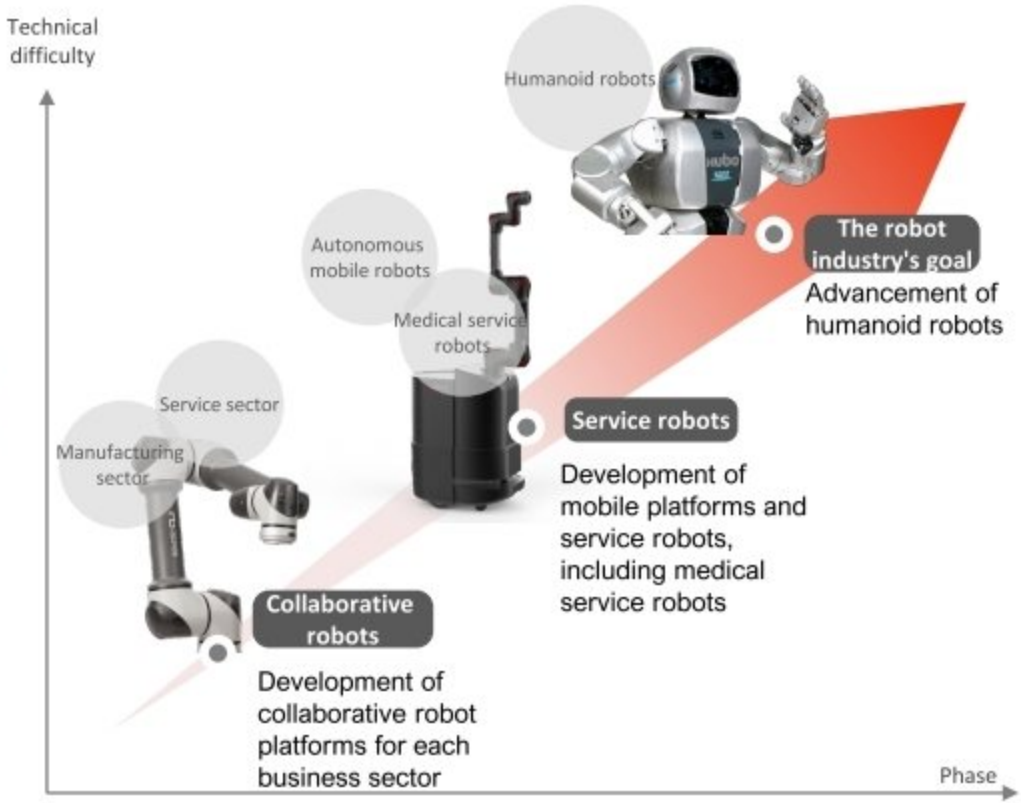
01. Business Expansion Strategy

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

Acquisition of essential technologies based on its core robot technologies



Expansion of application fields



02. Collaborative Robots, Increasingly at the Center of Attention in the Robot Industry

RAINBOW ROBOTICS

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

Production and manufacturing sectors





Service sector

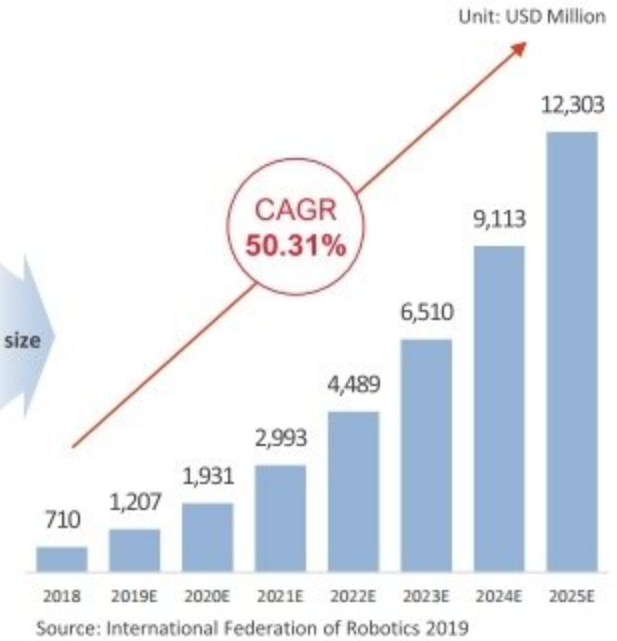




Application range



Market size



Source: International Federation of Robotics 2019

03. Reasons for Inevitable Growth in Collaborative Robots

RAINBOW ROBOTICS

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

Traditional industrial 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.

VS

Collaborative robots



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.)

04. Various Business Opportunities in the Collaborative Robot Market

RAINBOW ROBOTICS

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

05. Enhanced Engagement in Collaborative Robot Business

RAINBOW ROBOTICS

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 sale of the products



Core technological competencies

Software developed using proprietary technology

Has acquired robot control algorithms

Optimum product performance and easy maintenance

Key components developed using proprietary technology

Accounting for more than 60% of collaborative robot manufacturing costs

More price competitive when compared to its competitors

Customizing

Has laid out a wide range of collaborative robot product lines

Possible to enter various markets and industries

Capable of better responding to customer demands
in terms of product development
(performance ↑ , price ↓)



Application of collaborative robots in various production and manufacturing processes

06. 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	RAINBOW ROBOTICS
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



07. Generation of New Markets in Various Areas

RAINBOW ROBOTICS

The range of applications has extended from the manufacturing sector to different industries by providing customized solutions that reflect customer needs

F&B business underway (robot cafes)

Launched MIXX, an automated beverage-making platform using robots



MIXX Cocktail Robot


MIXX-Rai
(Samsung Raemian Gallery)


MIXX Ade Cafe
(As a public testbed project in the Daejeon Metropolitan City)

Business progress

- Discussing the supply of products to domestic and foreign universities (with a company that owns the right to operate food and beverage services in the US)
- Discussing building a brand with a global hotel chain
- Discussing the supply of products to major domestic brand apartments

Logistics business underway (post offices)

Participated in the automation of the parcel service and logistics of Korea Post


A loading/unloading logistics robot
(Ranked first in the demonstration test conducted by Korea Post)

Business progress

- Will be installed and operated at the Daejeon Mail Center first and then further applied to other mail centers and logistics centers on a phase-by-phase basis (21 mail centers and two logistics centers nationwide)
- Discussing its application to other logistics service companies since the conduct of the demonstration project

RAINBOW ROBOTICS

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