Active Rehabilitation Treatment Robot

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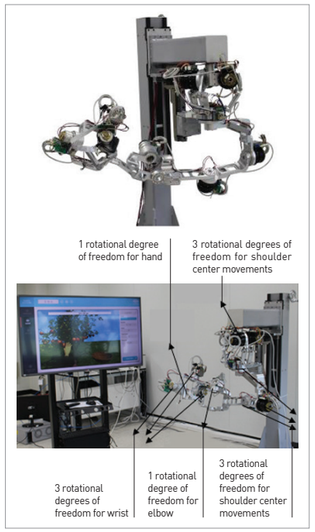
Internally, the technology for light but strong integrated actuator module was developed, which was only used for humanoids or high–tech industrial robots, and applied it to a rehabilitation robot for the first time to effectively help with rehabilitation treatment of joints in the upper limbs (hand, arm, shoulder) paralyzed from a stroke



Client / Market

- Senior medical & welfare facility, hospital

Necessity of this Technology

- The demand for upper limb rehabilitation robot technology has increased due to aging of population and increased number of patients with brain damage in advanced countries
- Existing technology had not considered or simplified the movement of humerus head that moves with shoulder movement and had limits with accurately delivering intended impedance to the patient.

Technical Differentiation

- 6 DOF nonlinear movement of the shoulder joint can be naturally implemented and the impedance delivered to the user is precisely controlled.
- The unified actuator module is small and light–weighted but with sufficient output and high safety and precision of the driving and sensing module. It can also implement high performance impedance control.
- Developed the automatic modeling of rehabilitation procedure of physical therapist that quantifies the treatment procedure when a physical therapist performs exercises using a rehabilitation robot on a patient.
- Instead of using a timing belt, it uses a 4–axis upper limb rehabilitation (3–axis for shoulder, 1–axis for elbow) mechanism and 3–axis hand rehabilitation (3–axis for wrist) mechanism.
- Using a torque sensor signal for each axis, high performance impedance control is possible. For the joint where a lot of weight is loaded, weight is not burdened to the patient using a brake in case of an unexpected situation.
- Based on the absolute encoder signal, the initial position is automatically set without having to readjust for every use. With double checking with the incremental encoder, the control safety is enhanced.

Excellence of Technology

- Developed a high–performance unified actuator module specialized for rehabilitation robots

DESIRED PARTNERSHIP

Technology Transfer | Licensing | Joint Research | Other

TECHNOLOGY READINESS LEVEL [TRL]

Research, basic explanation | Project concept or idea development | Technology idea verification | Prototype development | Trial product production/ evaluation in similar environment | Pilot field demonstration | Development and optimization of commercial model | Commercial product demonstration | Mass production and initial market launch

- Consists of a motor, a motor drive, a torque sensor, a harmonic drive, an incremental encoder, an absolute encoder, and a brake; a unified actuator module was designed and fabricated with all components with a thin, hollow shape to be assembled in one housing.
- Developed a prototype of 5th generation unified actuator module that emits the same output as the 1st generation integrated driving module developed in 2011 but has a weight that is 60% less
- Based on the 5th generation unified actuator module technology, developed a rehabilitation robot for customized treatment by joint for all upper limb movement for stroke patients
- Developed a GUI (graphic user interface) platform to link with the upper limb rehabilitation robot for patient condition measurement, rehabilitation protocol input, game treatment, and quantitative data storage and analysis

Internally Developed 1st to 5th–Gen Unified Actuator Module

GUI Developed for Connecting with the Upper Limb Rehabilitation Robot for Various Treatments Including Games

Comparison with 5th Generation Unified Actuator Module

Comparison with Existing Rehabilitation Robot (ArmeoPower, Switzerland)

	ArmeoPower	KIMM rehab robot
No. of joints	7	11
Patient's interaction force control	X	O
Should center movement	1 (passive)	3 (active)
Weight (kg)	18.8	9.6 (7 units), 15.3 (11 units)
Pay load (kg)	4.6	5.9

Current Intellectual Property Right Status

PATENT

- Robot for Rehabilitating an Upper Extremity (KR1465176)
- Parallel Manipulator (KR1817750)

KNOW–HOW

- Highspeed/Synchronization control of multi–axis driving module usin communication method
- Impedance controller design technology using analysis of system's dynamic properties
- Technology for modeling of nonlinear movement of shoulder joint