KULEX
KIST Upper Limb Exoskeleton
a novel power assistant robotic system for the elderly and disabled

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Koreate Institute of Science and Technology
Research Partners

Korea Government Project
Power Assistant Robotic Systems for the Elderly and Disabled
$12M (2010~2014)

KIST
(Korea Institute of Science and Technology)

Research Institute
KIST

LG
Life’s Good

Industrial Partner
LG Electronics

(National Rehabilitation Center)

Clinical Partner
NRC

(Upper Limb)

(Smart Sit-to-Stand)

(Clinical Research)
1. **Modular Systems**
   - for different levels of disability

2. **Ease of donning and doffing**
   - to prevent spastic paralysis, emergency escape

3. **Lightness or compactness**
   - for mobility to carry and mount at wheelchairs, beds, or tables
KULEX Modules

Serial Module

Wrist Module

Grasping
New Components of KULEX
Specifications of KULEX

Wrist 3DOF
Serial module Movement
1kg payload

Weight: 5.82kg

Wrist
Elbow
Shoulder

Comparison of ROM (Range of Motion)
Demonstration

KULEX Task - Brushing Teeth

March Lab. @ KIST

Spin-Off Tech Transfer

KULEX Task - ADL (Drink Water)

KULEX Task - Assistant Mode

KULEX Task - ADL (Pen Pinch)

March Lab. @ KIST

March Lab. @ KIST

March Lab. @ KIST
Approach: Bionic Interface

1. To catch human intention before action for intact body
2. To catch human intention for the disabled

<table>
<thead>
<tr>
<th>sEMG</th>
<th>Brain</th>
<th>Nerve</th>
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<table>
<thead>
<tr>
<th>Invasive</th>
<th>Brain</th>
<th>Muscle</th>
<th>Nerve</th>
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<tbody>
<tr>
<td></td>
<td>Brain</td>
<td>Invasive</td>
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<td>Non-Invasive</td>
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<tr>
<td></td>
<td>Brain</td>
<td>Muscle</td>
<td>Nerve</td>
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sEMG

Rest State

Transient State

Steady State

Before Action

After Action

~ 30ms
Start-Up (Capturing Human Motion Intention)

<table>
<thead>
<tr>
<th>Sensor Module</th>
<th>Cradle</th>
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<tbody>
<tr>
<td>Size</td>
<td>Size</td>
</tr>
<tr>
<td>▪ 50mm(W) x 23mm(L) x 18mm(H)</td>
<td>▪ 110mm(W) x 110mm(L) x 70mm(H)</td>
</tr>
<tr>
<td>CPU</td>
<td>CPU</td>
</tr>
<tr>
<td>▪ ARM Cortex-M4 @ 168MHz</td>
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</tr>
<tr>
<td>Connectivity</td>
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</tr>
<tr>
<td>▪ 2.4GHz RF Wireless with Chip Antenna</td>
<td>▪ Bluetooth 4.0</td>
</tr>
<tr>
<td>▪ USB 2.0</td>
<td>▪ Wifi (802.11 b/g/n)</td>
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<tr>
<td>Sensors</td>
<td>Peripherals</td>
</tr>
<tr>
<td>▪ sEMG (16 Sensors Max @ 1KHz Sampling frequency)</td>
<td>▪ Charging</td>
</tr>
<tr>
<td>▪ 9-axis Motion Sensor(1KHz ~ 62.5Hz Sampling frequency)</td>
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<tr>
<td>▪ 4 x Touch Sensor</td>
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<tr>
<td>Peripherals</td>
<td>Applications</td>
</tr>
<tr>
<td>▪ Vibrator</td>
<td>▪ Pattern Recognition</td>
</tr>
<tr>
<td>▪ 5 x RGB LED</td>
<td>▪ Motion Capture</td>
</tr>
<tr>
<td>▪ sEMG Gain tuning(x1 ~ x200)</td>
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</table>
Acknowledgment

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http://march.kist.re.kr

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THANK YOU.