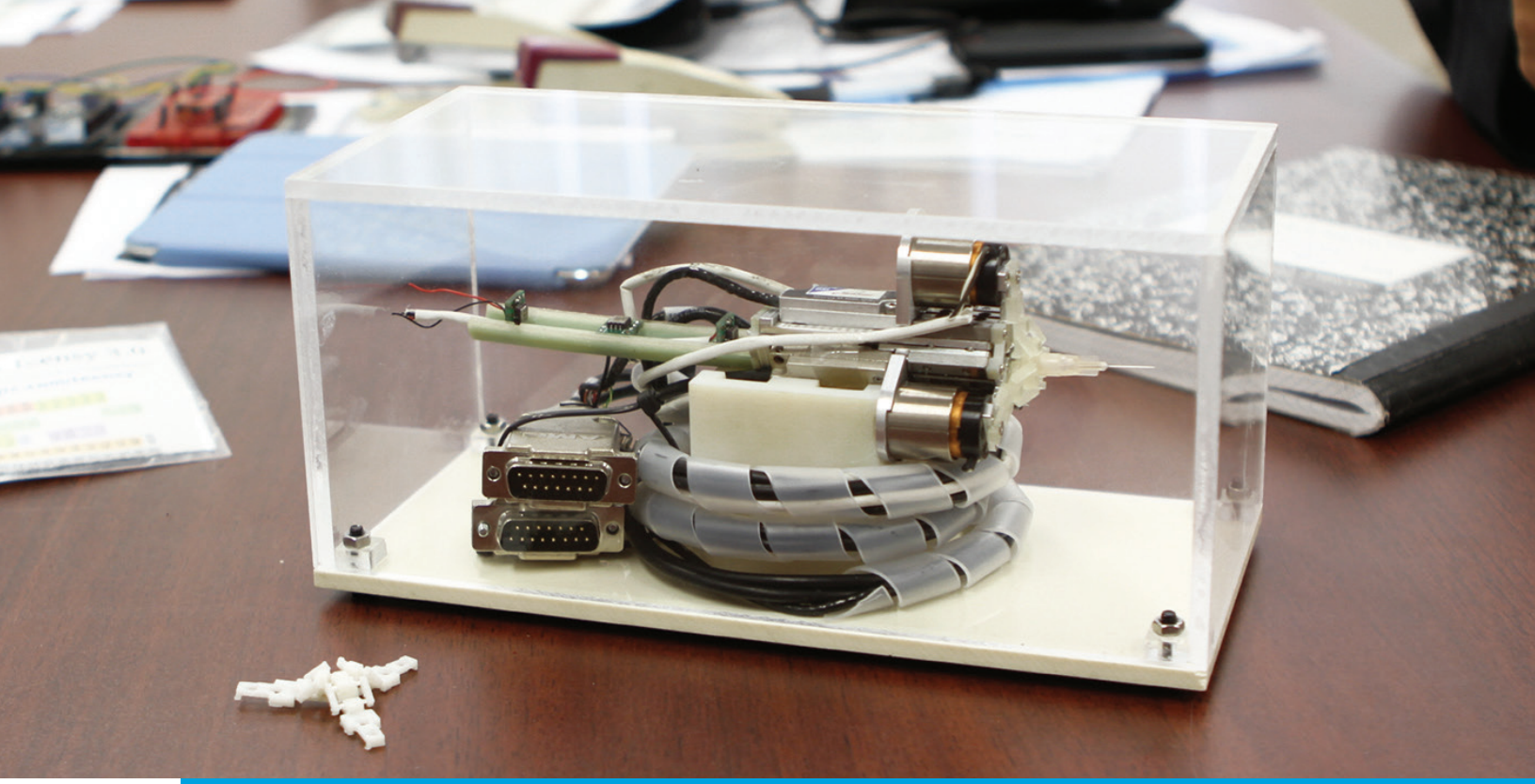


"3D printing enabled us to quickly identify design flaws overnight instead of waiting for days or weeks."

Professor Jung Kim / Korea Advanced Institute of Science and Technology

CASE STUDY

Engineering Biosignal Therapy

FDM IMPROVES BIOENGINEERING RESEARCH AT KAIST BIOROBOTICS LAB

At the Biorobotics Lab in the Mechanical Engineering Department of the Korea Advanced Institute of Science and Technology (KAIST), Professor Jung Kim and fellow researchers developed a device to help patients with Essential Tremor (ET), a neurological disorder characterized by uncontrollable tremors that hinder millions of patients worldwide from performing precise tasks such as writing, eating and getting dressed.

Kim and researchers created a wearable auxiliary device that measures, monitors and analyzes the electromyogram (EMG) signals of patient — bio-signals that are emitted from muscle cells when electrically or neurologically stimulated. The device detects any irregular EMG signal and stabilizes movements of the patient's shaking hands through the sensor-equipped diagnostic tips.

Finding the Precise 3D Printing Solution

Producing a perfect auxiliary device was challenging with its complicated design, multiple small components, and the need for high mechanical strength and flexibility from the ever-changing bio-signal value. Prior to 3D printing, the team outsourced prototypes, which took up to four weeks to generate and often resulted in a prolonged validation process. Outsourced prototypes varied in quality and did not provide accurate data for validation.

“Precision is of utmost importance to us as we need to ensure that every electronic or engineering component is well-fitted into the ET-auxiliary device, such that transmission of EMG signal from the patient to the device is smooth for the device to serve its purpose,” said Professor Kim.

Bridging the gap between CAD design and a functional prototype was possible with Stratasys 3D printers at the KAIST Biorobotics Lab. KAIST also invested in 3D printing for staff to better communicate engineering theories through customized 3D printed models. The school’s management board believes 3D printing is a rising technology among key industries, making it necessary to equip students with the latest technology before they enter the competitive market.

Prototyping With Durable Materials

Realizing the benefits of 3D printing, Professor Kim and his team 3D printed components and movable parts of the auxiliary device. CAD design was converted into printable STL format with the built-in CatalystEX™ and the parts were created in engineering-grade ABS*plus*™ thermoplastic for its strength and durability to withstand functional tests.

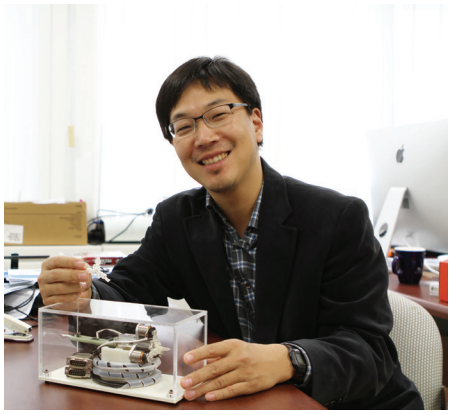
The team 3D printed prototypes of the skeleton and smaller components of the auxiliary device, including gears, cogs, hinges and diagnostic tips. The 3D printed parts and other electronics parts were assembled as a final mock-up for clinical experiments, which proved to be successful in helping ET-patients monitor and stabilize their involuntary hand movements.

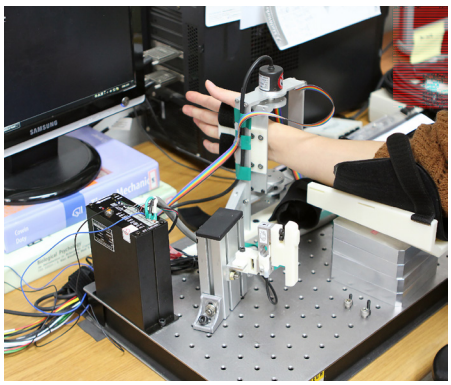
“3D printing enabled us to quickly identify design flaws overnight instead of waiting for days or weeks,” said Professor Kim. “We can produce multiple component prototypes in our office for design verification and assembly tests in one print, and adjust the CAD file accordingly until all requirements are satisfied and everyone is happy. This has greatly accelerated our project schedule and given us extra time to produce other lab tools as well.”

Taking Bioengineering to New Heights

Since investing in 3D printing, the Mechanical Engineering Department has been putting it to full use by producing prototypes of robotic exoskeletons and customized jigs and fixtures for various research. Other bioengineering teams have extended the use of 3D printing into prototyping devices for cancer diagnostic tools, screening tools and MRI scanners that detect different bio-signals.

“3D printing has been a very good experience for both researchers and students at the university. It is efficient in building prototypes, effective in assisting with our research experiments and easy to use for both researchers and students. We couldn’t have accomplished as many research projects as we can now without a professional 3D printer,” said Professor Kim.





Professor Kim and researchers 3D printed prototypes of the skeleton and different smaller components of the auxiliary device, including gears, cogs, hinges and diagnostic tips.

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