Marsi Bionics

Marsi Bionics was created in 2013 as a spin-off of the Centro de Automática y Robótica (CAR), a joint centre between the Consejo Superior de Investigaciones Científicas (CSIC) and the Universidad Politécnica de Madrid (UPM), transferring more than 20 years of know-how in robot locomotion. **Exceptionally, the CSIC has been a shareholder of Marsi Bionics since 2019.**

Marsi Bionics' major milestone has been to develop the world's first children's exoskeleton. There is no similar technology that allows 360° movement for children who cannot walk or who have lost the ability to walk.

It is a 100% success story of knowledge transfer in Spain. It was born from public research (2009) with a very personal story: the parents of Daniela, a girl who became paraplegic after an accident, approached the CSIC to look for a project that could help her walk. That is where the 'first steps' of the exoskeleton began. Once the project was completed, with a first prototype, Elena García Armada decided to create Marsi Bionics (2013) to transfer the results of the research to society.

From 2013 to 2021, Marsi Bionics finances, develops, industrialises, performs clinical research and certifies the device, which received the CE marking from the Spanish Agency for Medicines and Medical Devices in May 2021.

There is now distribution both in Spain and internationally. This process is the culmination of 8 years of knowledge transfer: from public research to hospitals and rehabilitation centres around the world.

Elena García Armada

Founder, promoter and director of the project, Elena García is considered one of the 10 most renowned scientists at the CSIC and one of the 30 most influential women in the world in the field of robotics.

He has more than 50 awards to his name. Among the most outstanding are the Castilla y León Award 2024 for Scientific and Technical Research and Innovation, the Queen Letizia National Disability Award from the Royal Board on Disability, the European Inventor of the Year Award from the European Patent Office, an international recognition that only two other Spaniards hold: Margarita Salas and José Luis Gómez (Talgo), the Gold Medal from the Red Cross and the Discapnet Award from the ONCE Foundation.

She is currently a member of the jury of the Princess of Asturias Award for Technical and Scientific Research and in 2022 she became the fifth woman to become an Academician of the Royal Academy of Engineering.

Paediatric exoskeleton

17 million children in the world are unable to walk due to neurological disorders of all kinds. And this lack of movement, beyond the difficulty in carrying out any activity, generates, above all, complications that affect the patient's quality of life and life expectancy. In order to provide a solution, Elena García Armada and her team have combined health with robotic technology and artificial intelligence to develop the world's first paediatric exoskeleton.

The exoskeleton is a device that adapts to the child's body to enable the child to stand and walk. It has 8 joints, with internationally patented technology, which imitate the functioning of natural muscle. This is achieved thanks to the concept of biomimicry.

The joint technology is elastic, which allows us to adapt to the child's muscular condition.

It has two modes of operation. The passive mode where the legs move automatically according to a configuration tailored to the child. And the movement intention mode that requires the child to exert a certain force - selected by the therapist - in order for the exoskeleton to move forward.

The exoskeleton is able to adapt its stiffness intelligently to different pathologies: from spinal muscular atrophy (SMA), a rare disease characterised by muscle weakness, to more spastic and dystonic conditions such as infantile cerebral palsy, which is the leading cause of motor disability in children.

What does the use of the exoskeleton entail?

The advance of this technology means changing the paradigm of rehabilitation of neuromuscular pathologies in childhood. Thanks to robotics, children who have never walked can stand up, and this is a fundamental change. Giving children the opportunity to move around in space means changing the concept of rehabilitation. It is no longer a machine or a person who forces you to make certain movements, but it is the child, in his or her eagerness to move, explore and play, who is working. And this produces effects that go beyond the muscular: we are talking about changing their visual field and the way they move, we are talking about self-confidence, security, voice projection. Getting a child who has never walked before to walk in an effective and real way is an opportunity for physical improvement, but also for personal growth.

Explanatory video for use by children, families and doctors at the Hospital Universitario La Paz: https://youtu.be/qwLZKlM95X4

Benefits

The human body is made for standing. That is why it is vital for children who have been in a wheelchair all their lives to be able to stand upright. Cardiorespiratory, muscular, gastrointestinal...

There are, of course, important clinical benefits. We are talking about respiratory improvement, strengthening of the thoracic and cephalic musculature, which leads to a delay in the musculoskeletal complications of their pathologies. But the change that occurs on a psychological and personal development level is vital: improved attention at school, improved sociability, motivation, self-perception and even autonomy to carry out daily activities such as eating on their own. And these changes are as or more important than the physical ones because we are talking about children in the midst of a process of personal growth.

These are some of the testimonies of patients and relatives: https://www.marsibionics.com/atlas-pediatric-exo/#expertos

EXPLORER, an exoskeleton for everyday use

EXPLORER is the first personal exoskeleton for children for everyday use that introduces a paradigm shift in motor rehabilitation by taking this technology out of the clinical environment and bringing it into homes for personal use in outdoor settings.

Developed by Marsi Bionics, a company that started as a spin-off from the CSIC, this device focuses on providing an effective and accessible solution for children with walking disorders caused by neuromuscular diseases, cerebral palsy, spinal cord injury and other conditions that affect mobility.

Features

EXPLORER has four motors that mimic the natural functioning of muscles and two operating modes: one for force activation, through which the exoskeleton provides the force necessary to move forward, and another automatic mode, which generates constant movement at the selected speed.

Another feature of EXPLORER is that it is scalable, adapting to the natural growth of children aged approximately 2 to 17 years old. It also has an innovative automatic seat that allows the device to be transformed into an integrated reclining chair, facilitating continuous use and comfort for children in their daily lives, both indoors and outdoors.

EXPLORER is easy to put on, has a battery life of 6 hours of continuous use, and is controlled from a highly intuitive app that collects information about the child, thus facilitating autonomy for families in the daily use of the device.

This exoskeleton is inclusive, as its outdoor use encourages participation in everyday activities, such as playing in the park, getting around the city or taking part in family leisure activities with greater autonomy, confidence and independence. But it also facilitates rehabilitation, as it allows the child to engage in regular physical activity, thus following the WHO recommendation of 60 minutes of moderate to intense exercise per day.

Its many benefits are backed by clinical studies that highlight, among other things, improved motor function, range of motion and spasticity; stimulation of confidence and social integration; improved cardiovascular, respiratory and gastrointestinal systems; contribution to the child's physical and emotional development; and physical activity. Learn more about EXPLORER in this video.

The origin

EXPLORER was born from the request of children who were already familiar with ATLAS 2030, the paediatric exoskeleton for clinical use, and who wanted to be able to take it beyond the hospital or rehabilitation centre and use it for longer than the duration of a session.

Jorge with his ‘exo school’, Rocío with her ‘exo communion’ and Alex with his ‘exo park’ made it clear to us that the children themselves wanted a device that would be part of their daily lives, allowing them to explore their environment naturally, without restrictions, and in the company of friends and family.

Based on their voices, what is now the first exoskeleton for personal use by children has become a reality.

A public-private research project

EXPLORER is the result of a public-private partnership between Marsi Bionics, the CSIC and four of the main public hospitals in the Community of Madrid (La Paz, 12 de Octubre, Niño Jesús and Gregorio Marañón), with the support of the Ministry of Science, Innovation and Universities through the PERTE for Cutting-Edge Health.

To develop this exoskeleton, nearly 30 researchers from these four hospitals have been working closely with Marsi and the nearly 70 children and families who have participated in the two clinical trials conducted so far. This work is particularly focused on ensuring the safety and efficacy of the device and bringing the latest technologies closer to the child's immediate environment, encouraging their participation. A third study involving 14 families is currently underway.

In addition to these 30 researchers, including physiotherapists, rehabilitation doctors and other specialists, there are those contributed by the CSIC, another fundamental pillar of the project. A team of 15 researchers from the Centre for Automation and Robotics (CAR-CSIC-UPM) has contributed its extensive experience in robotics applied to health and is a testament to the power of science at the service of people.

More information here.