RoboGym

RoboGym for strength training

Challenges for Strength Training

Strength training requires precise, guided movements with a high level of exertion as part of safe, efficient training. These requirements apply to different training purposes, such as rehabilitation, preventing muscular strength loss or building muscles for high-performance sports. Within these fields of application, the needs for the musculoskeletal system of the athletes differ greatly. Therefore, continuous monitoring and analysis of strength training and individualized setup is required to prevent training-induced injuries and for maximum effectiveness.

The RoboGym Solution

The robot training system uses sensors to capture the athlete's movement in real-time. Based on a biomechanical musculoskeletal model, RoboGym identifies whether the athlete is working out in the most efficient and ergonomic motion range. The direct **bio-feedback** helps you avoid injuries to your joints. All training data are fed into your own **digital twin** in the cloud, and so they are available for your individual use, anytime and anywhere. The high level of **adaptability and adjustability** of the robot offers an immense variety of training possibilities, which makes your training more **comfortable and time efficient**. The system is developed with highest focus on **safe** human-robot interaction.

System Features

Adaptability, Adjustment to individual needs

RoboGym provides a huge variety of training. Different adaptors, modes, exercise styles, seat positioning, etc. allows training adjustable to each requirenment. Athletes can either train with the certified training by the German Sport University Cologne or adjust the training to their needs, developing new training regimes, adaptors or modes in cooperation with BEC and the German Sport University Cologne for exercises which are not possible with other training devices.

Direct Bio-Feedback

RoboGym shows you direct bio-feedback on your movements. To do this, a screen shows you the load within your biological structure, and the force sensor plate shows you your performance and guides you through the training.

System Features

Comfortable and time efficient training

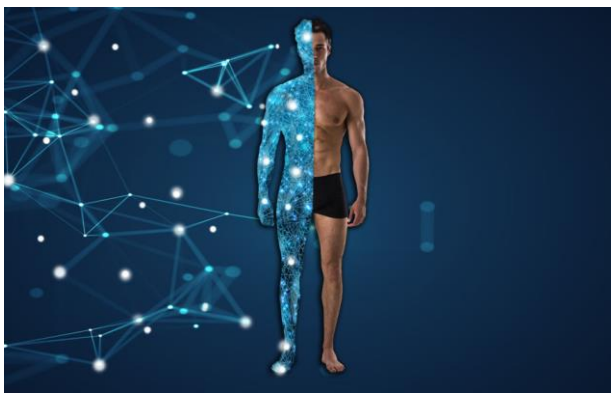
RoboGym let you start your training in just a few seconds. A huge database with your anthropometrics, training history, last device set up and pre-defined training saves you time, but is still flexible at the same time. The database can be saved to a cloud system, so it is available everywhere.

Safe training device

RoboGym is an interactive system that stops immediately if an unsafe position is detected or if the user releases the force. With personalized security areas based on your anatomy, the robot can never get too close and dangerous situations are avoided. Since the force is controlled by the robot in relation to human anatomy, joint and muscle overload is avoided.

Digital Twin

RoboGym is the only training device that measures the forces and torques in your biological structure, since other training devices can only measure the load within the machine. We use the input from the machine as input data for the biomechanical human model, so we can calculate the load on each joint in real time.



RoboGym heart and soul

Hardware

The main component of the RoboGym is a KUKA robot that can operate in three force directions and three directions for the torque. This flexibility of movement allows the user to operate in a wide range of dimensions.

Mounted on the robot arm is a sensor, which is the interface between the robot and the user. The force and torque sensors measure the activity of the user in real time and deliver the data to the analysis system.

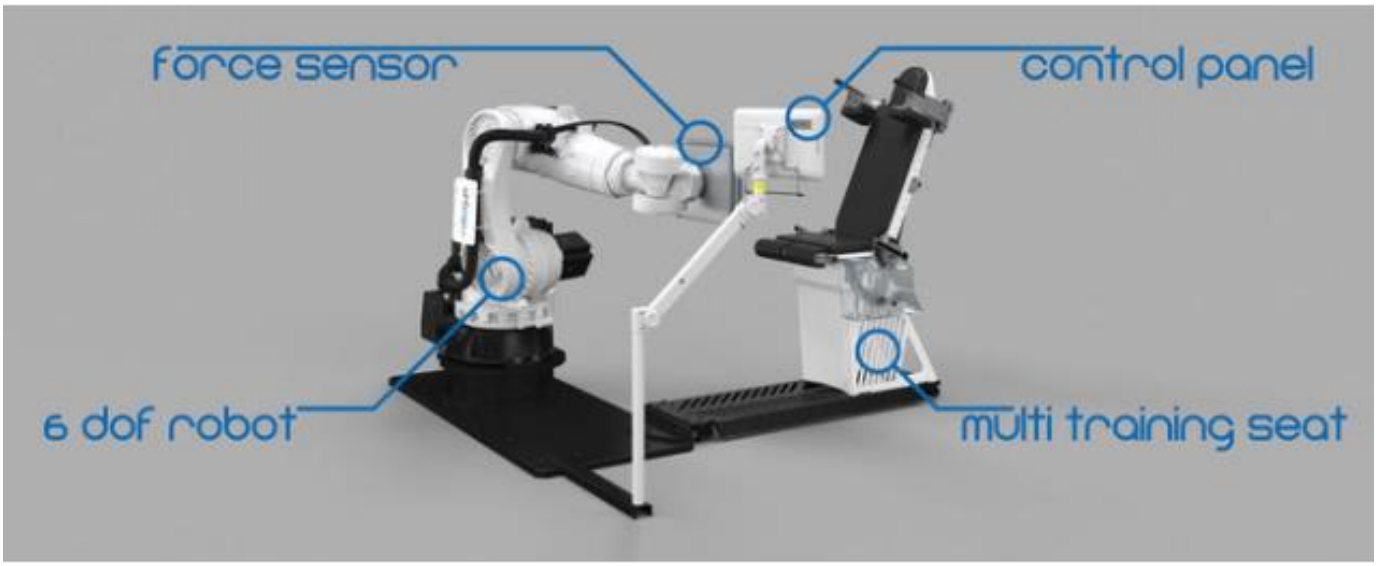
Furthermore, the multi-training seat offers users a variety of ways of positioning their bodies for different exercises. Next to the seat are two handles with an activator button to make the robot move for the exercises.

A 23-inch touch panel is mounted on a flexible arm as an interface to operate the robot and view the results.

In addition, for different training modes, different hardware adapters can be attached to the robot with a small plug. The robot can detect which adapter is plugged in, so the pre-set training is already selected.

Software

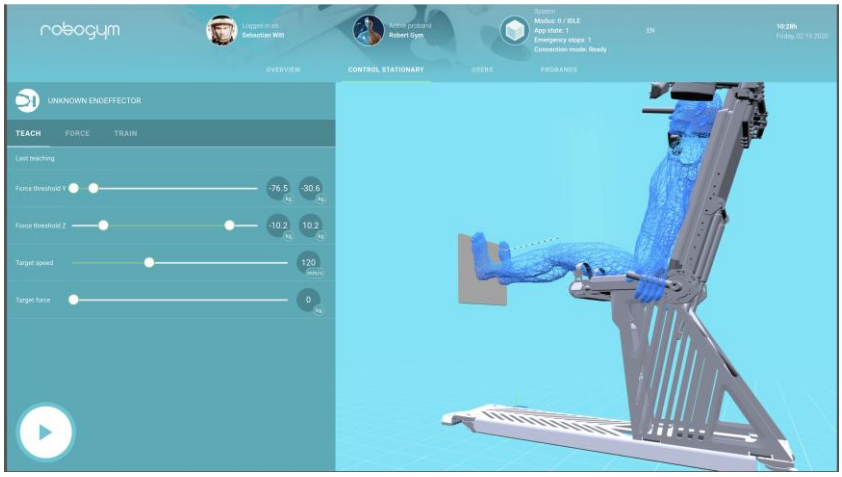
The robot software is divided into different areas of robot control, data collection from the user, interpretation of the data and display of the analysis results. That being said, the main focus of software development is user safety. This is implemented in the operation of the robot, as well as in the analysis results to offer the user safe strength training.



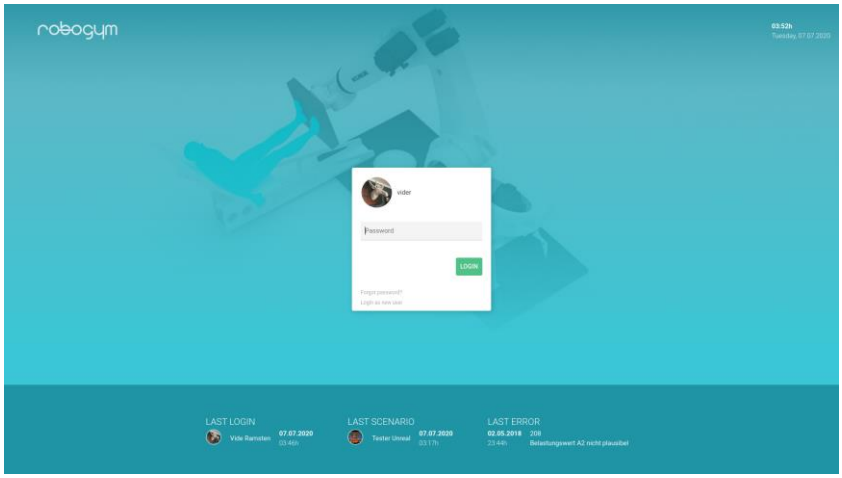
User Interface

The graphic interface performs two main functions: it controls the robot and informs the user. For robot control, the trainer can select parameters for the training, such as which exercise, the number of repetitions, the number of sets, etc.

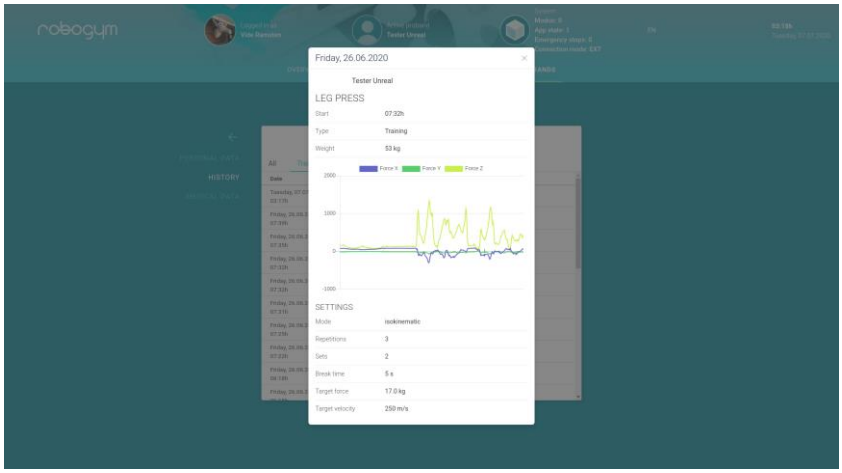
On the other hand, the interface shows the user the personal data in their profile, their training performance and also documents their training history.



Set up parameter for training and Digital Twin.



Log in for user profile.



Trainings history with saved parameters.

Multiple Training

With the robot as a training partner, the system is flexible in six different dimensions (force in three directions and torque in three dimensions). Therefore, where different machines are normally required for different exercises, RoboGym is an all-in-one solution. RoboGym offers you the option to choose between pre-defined training or gives free rein to your creativity to develop your own training regime. All these settings are saved in the database and can be pre-selected at any time.

You can choose between different **adaptors, modes** and **styles**.

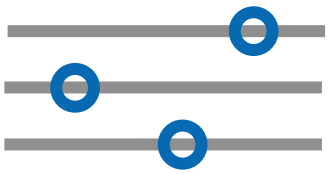
Adaptors: Currently three adaptors are available for the leg press, knee extensions and rowing are available. But since the direction of movement can be adjusted individually, several exercises are possible with these three adaptors.
Modes: The possibility to choose between isokinetic and isotonic training modes offers the potential for new training possibilities.

- Isotonic training is training with constant force. An example is training with weight machines.
- Isokinetic training is training with constant speed. RoboGym maintains the speed for concentric and eccentric exercises.

Styles: RoboGym offers a linear and an elliptic movement path based on your individual start and end point.

Want more? Contact us to develop new adaptors, modes, styles, etc.

Workflow

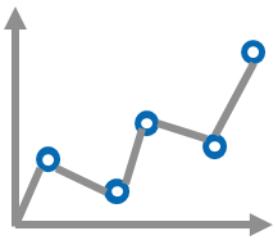


1. Set up Training

After you log into your profile, you can choose between different diagnostic programs (maximum voluntary force, range of motion) or start immediately by selecting the training parameters. Choose between multiple adaptors, modes, styles and movement directions.

2. Start your Training

Start your training. The robot will once more move slowly within your range of movement and then the training can start. During the training, RoboGym will continuously analyse the athletes movement and generated force which allows the instructor to optimize the training.

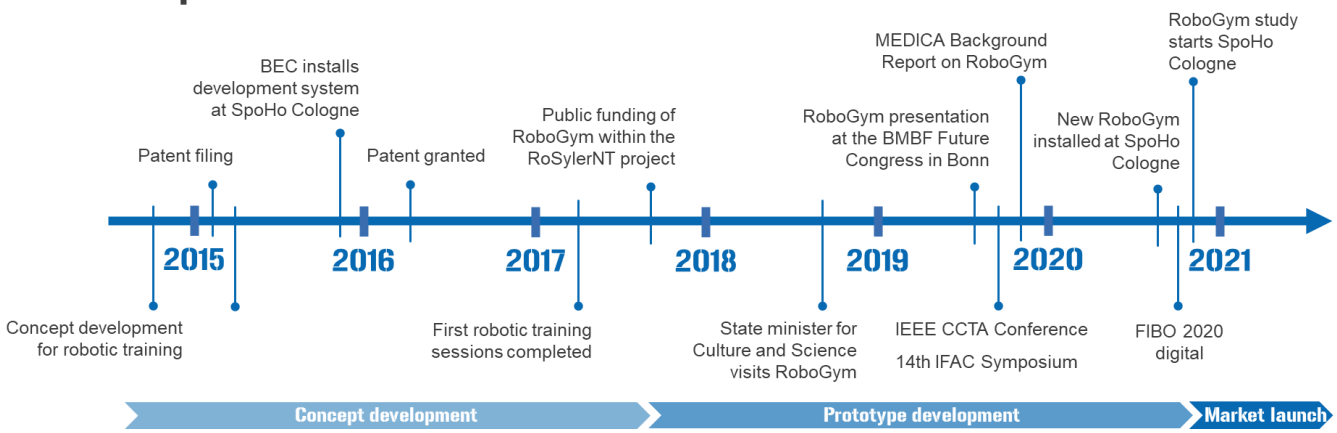


3. Analyse the Results

All your training parameters and achievements are saved to your digital twin, so they can be easily reused for the next training session.

RoboGym Roadmap and Team

Roadmap



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“We investigate human movement, the biological structure and function of the musculoskeletal system. The integrative RoboGym approach combines neurophysiological and biomechanical aspects resulting in a novel Human-in-the-loop concept for neuromuscular training.”

BEC GMBH

“BEC is a leading specialist in human-robot cooperation for industry, medical devices and entertainment. With inventive talent and the aim of finding clever solutions, our team develops technically challenging and safety-conscious relevant robotic applications for well-known customers worldwide.”

Scientific Proof

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RoboGym Webpage

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