



ROBOTEL *Türkiye*

## Open Source Mechanical Hands and Accessories for Kids with Limb Differences

In collaboration with Robotel Türkiye

*Uzuv Farklılıkları Olan Çocuklar İçin Açık Kaynaklı Mekanik Eller ve Aksesuarlar  
Robotel Türkiye ile işbirliğiyle*







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**Editors / Editors**

Sedef Süner-Pla-Cerdà

Mehmet Erçin Okursoy

Dilruba Oğur

**Cover Graphic and Page Layout Design / Kapak Grafiği ve Sayfa Düzeni**  
Zeynep Emiroğlu

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## 3D PRINTED SOLUTIONS FOR CHILDREN WITH LIMB DIFFERENCES

**Robotel** is an NGO fabricating free tailor-made 3D-printed mechanical hands/arms for children with limb differences. These limb differences can be seen among children resulting from genetic disorders from birth or amputations due to other health problems, accidents, wars, disasters, etc. The use of bionic arms among children is not an available option in the current health economy due to the rapid growth rate of children. Thus alternative solutions are being developed by using rapid manufacturing techniques for bespoke body-powered mechanical arms and hands. The aim of this project is to contribute to the open-source inventory with either accessories for the existing hands or new mechanical hands for specific use scenarios.

**Project Team:** Dr. Mehmet Erçin Okursoy, Dr. Dilruba Oğur

**Special thanks to** Robotel team Zeynep Karagöz, Serdar Okumuş, Beyzanur Koç, Eda Malkav, Selin Karaaslan, and dear Yağmur Karaaslan for their contributions.

## UZUV FARKLILIĞI OLAN ÇOCUKLAR İÇİN 3 BOYUTLU BASILMIŞ ÇÖZÜMLER

**Robotel** uzuv farklılığı olan çocuklar için kişiye özel üç boyutlu basılmış mekanik el/kol üretiminin ücretsiz yapıldığı bir sivil toplum kuruluşudur. Bu uzuv farklılıkları çocuklarda doğuştan genetik bozuklardan ya da sağlık sorunları, kazalar, savaş, afetler, vb. sebeplerle yapılan amputasyonlardan ötürü görülebilir. Çocuklardaki hızlı büyüme hızı nedeniyle mevcut sağlık ekonomisinde biyonik kolların çocuklarda kullanılması ulaşılabilir bir seçenek değildir. Bu sebeple hızlı üretim tekniklerinin kullanıldığı özel üretim mekanik el ve kollar alternatif çözümler olarak geliştirilmektedir. Bu projenin amacı var olan eller için aksesuarlar ya da özel kullanım senaryoları için yeni mekanik ellerle açık kaynak envanterine katkıda bulunmaktır.

**Proje ekibi:** Dr. Mehmet Erçin Okursoy, Dr. Dilruba Oğur

**Katkıları için** Robotel ekibi Zeynep Karagöz, Serdar Okumuş, Beyzanur Koç, Eda Malkav, Selin Karaaslan ve sevgili Yağmur Karaaslan'a teşekkürler.

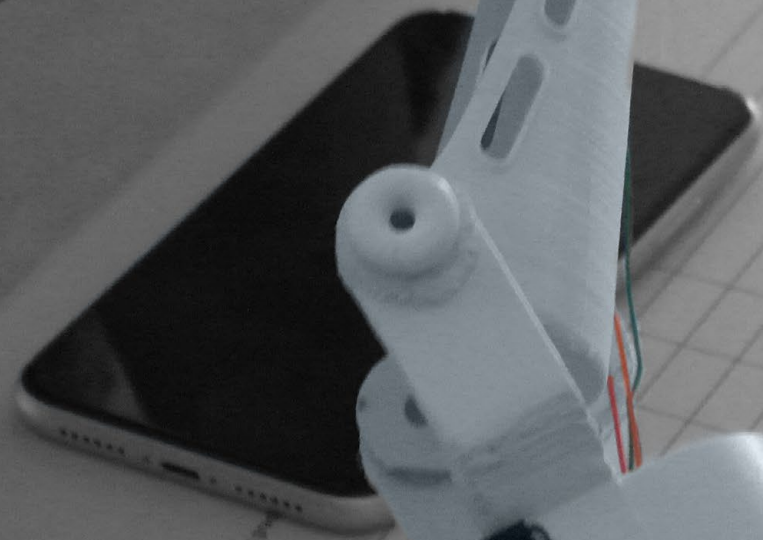
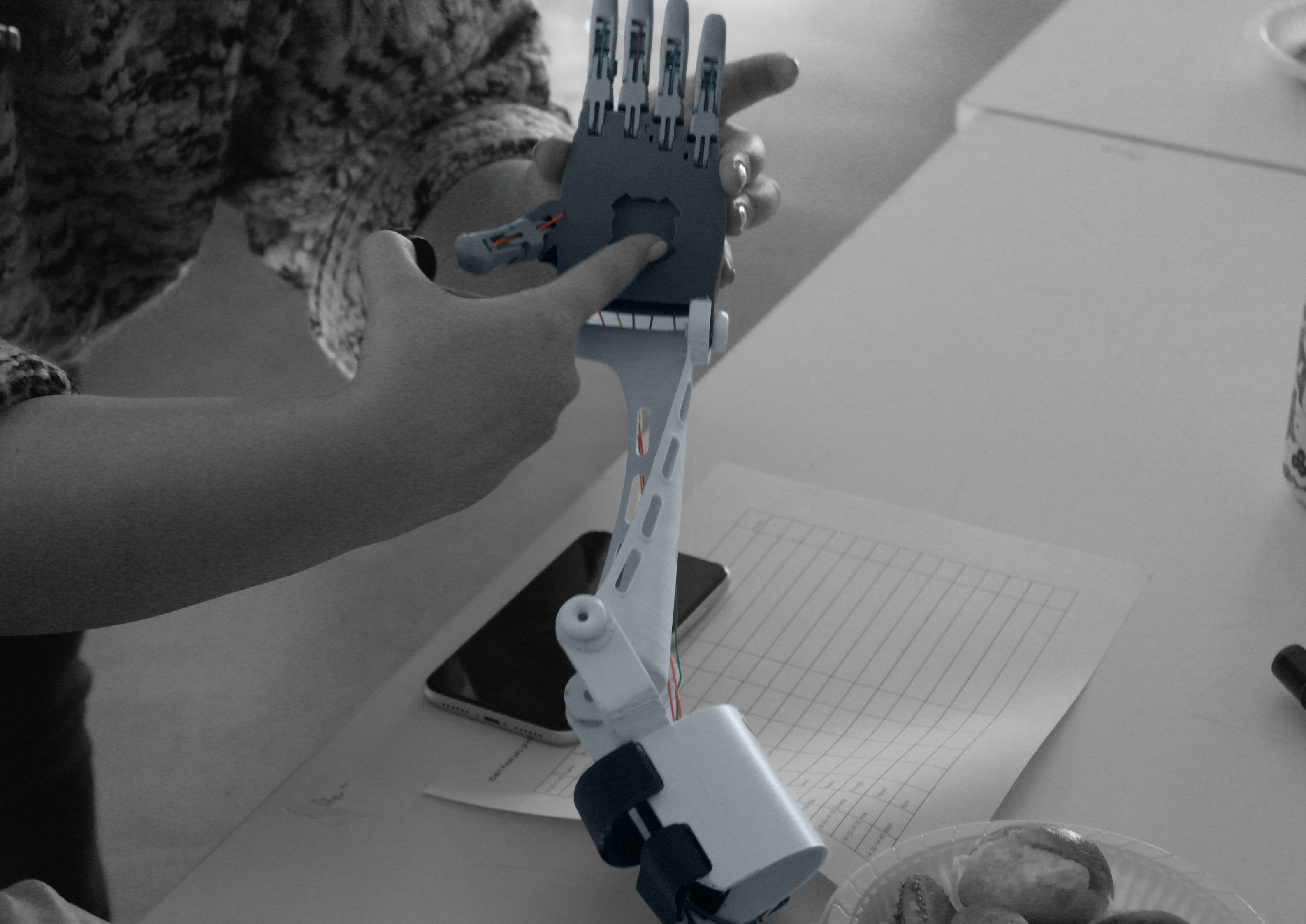
















**Designer / Tasarımcı**  
Arus Aze Yıldırım

# LIMBOW

**Limbow is a 3D printed bow holder designed to enable playing the violin.**

*Limbow uzuv farklılıkları olan çocukların keman çalabilmesi için tasarlanmış 3B baskı yay tutacağıdır.*

**Limbow is a 3d printed bow holder designed to enable playing the violin for people with limb differences, especially kids. It is a mechanical apparatus which has customizable accessories for the kids have fun and feel a sense of belonging.**

*Limbow, uzuv farklılıkları olan kişilerin, özellikle çocukların, keman çalabilmesi için tasarlanmış 3 boyutlu basılan bir yay tutucudur. Çocukların eğlenmesi ve aidiyet hissetmesi için özelleştirilebilir aksesuarları olan mekanik bir aparattır.*



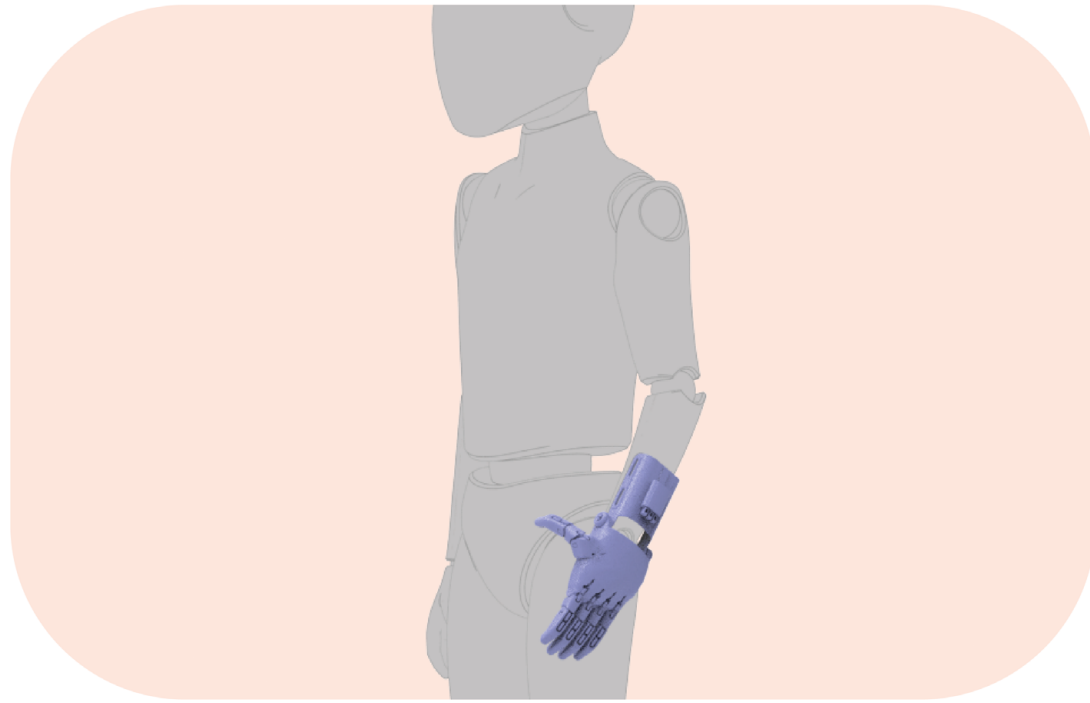
# LIMBOW

Limbow is a 3d printed bow holder designed to enable playing the violin.

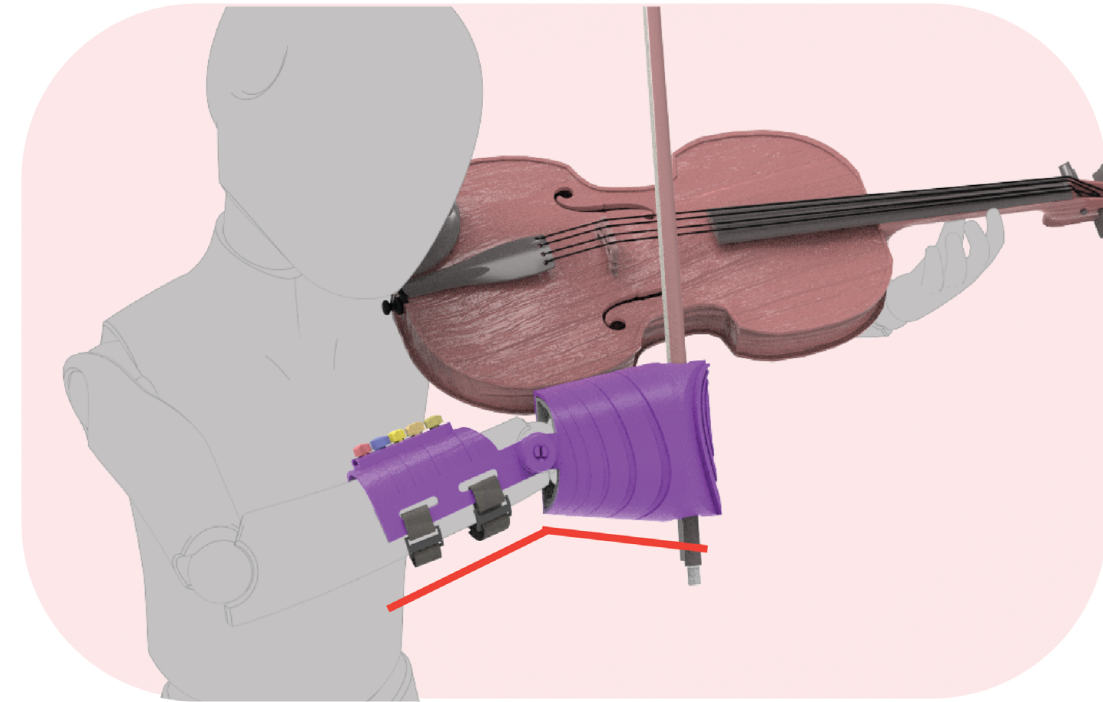




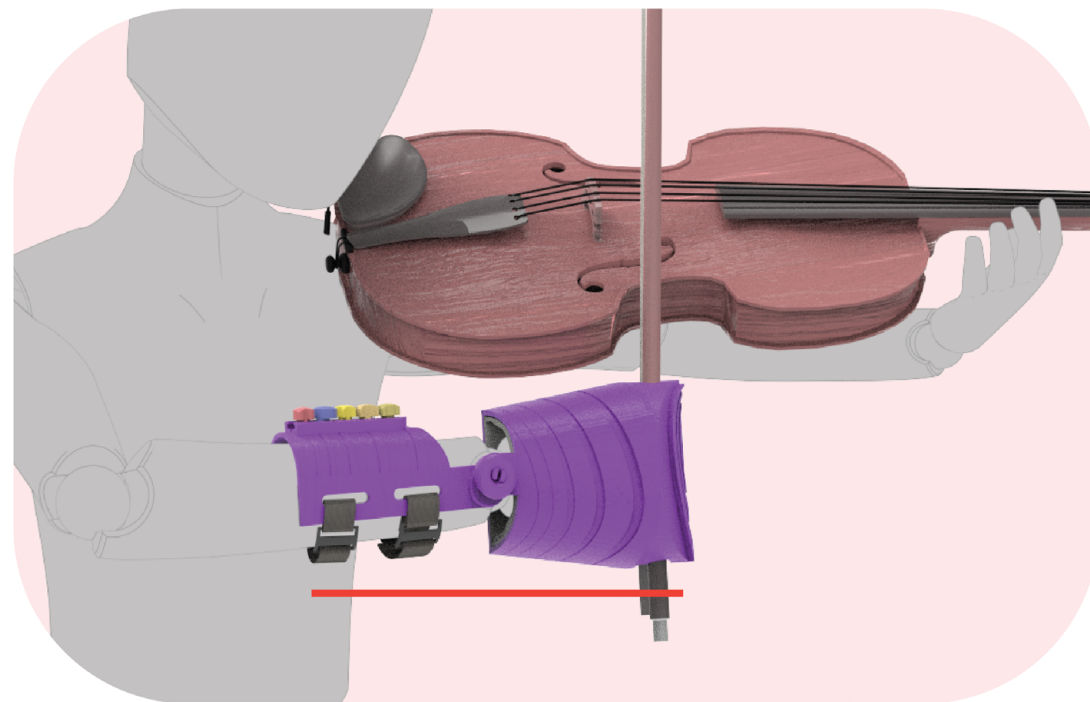
# SCENARIO LIMBOW



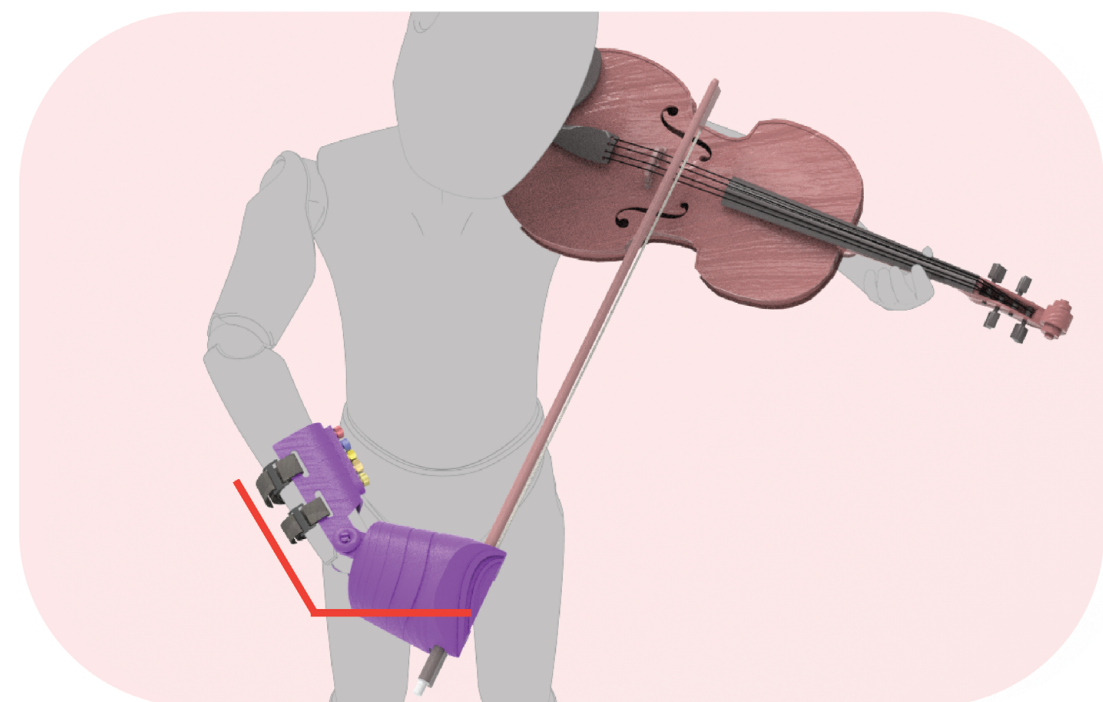
Most used prosthetic hand cannot provide the necessary movements for playing violin.



The child uses Limbow when they want to play the violin.



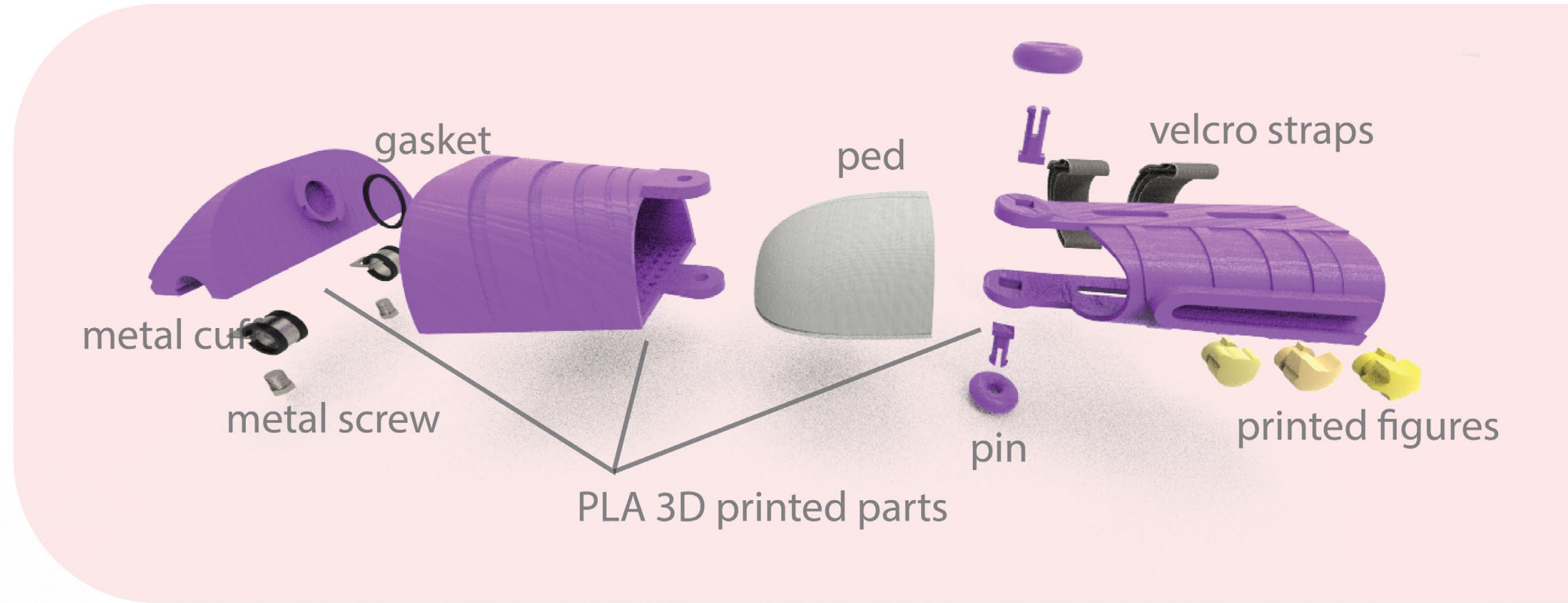
Depending on their wrist and elbow placement Limbow can adapt to the movement and enable them to play and learn the violin.



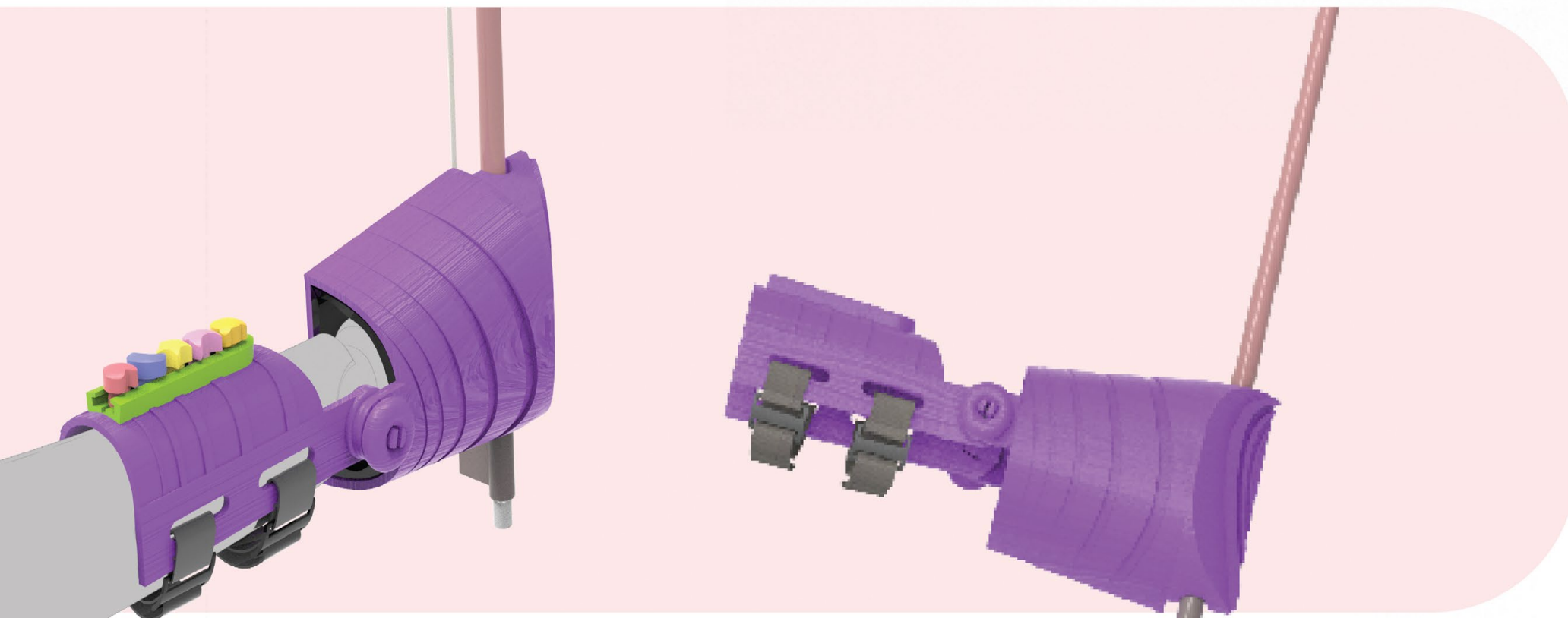


# DETAILS LIMBOW

## CUSTOMIZATION



## PROTOTYPE







Designer / Tasarımcı  
Betil Kuru

# LEGO PLAY

3D Printed modular mechanical hand specialized for playing with Legos.

*Legolarla oynamak için özelleşmiş 3B baskı modüler mekanik el.*

**LegoPlay is an entertainment set designed for children with limb differences compatible with lego bricks. It is the adaptation of the working principle of the lego game to UnLimbited hand. It aims to turn playing with Lego a more enjoyable and easy experience for children.**

*LegoPlay, lego parçalarıyla ile uyumlu uzuv farklılıkları olan çocuklar için tasarlanmış bir eğlence setidir. Lego oyununun çalışma prensibinin UnLimbited hand modeline uyarlanmış halidir. Lego oynamayı çocuklar için daha keyifli ve kolay bir deneyim haline getirmeyi amaçlar.*



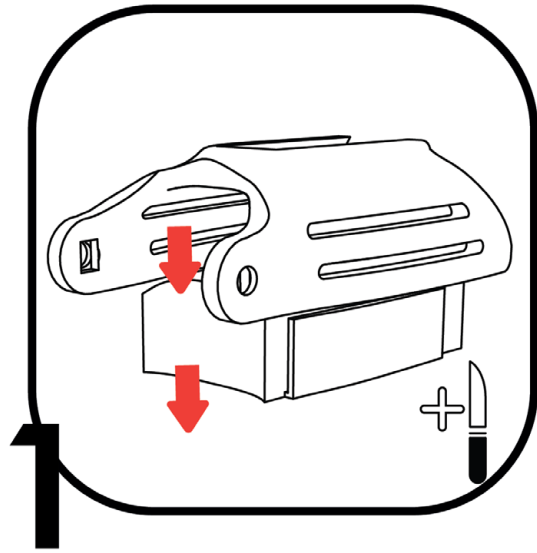
# lego play



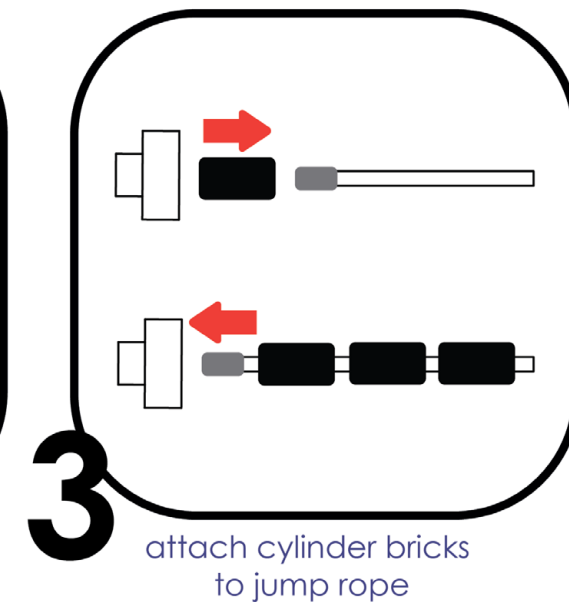
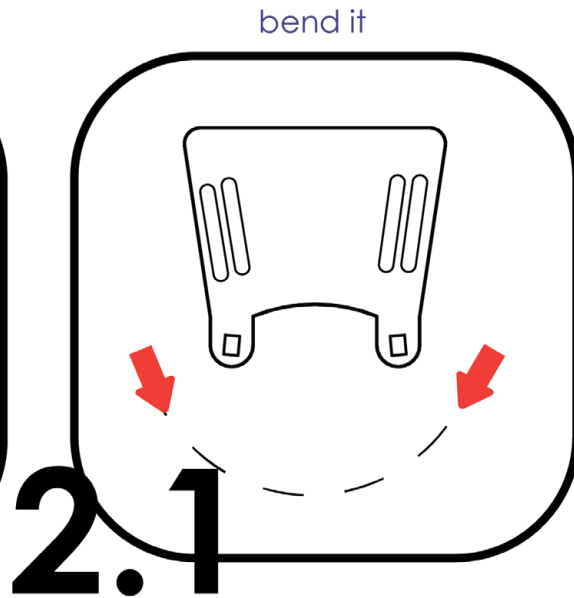
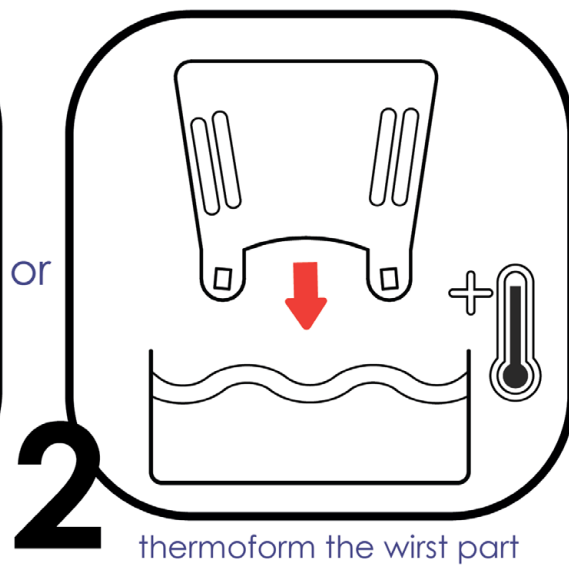


# SCENARIO LEGO PLAY

remove the support structure,  
with any edged tool in between  
the wrist part and the support  
structure and twisting



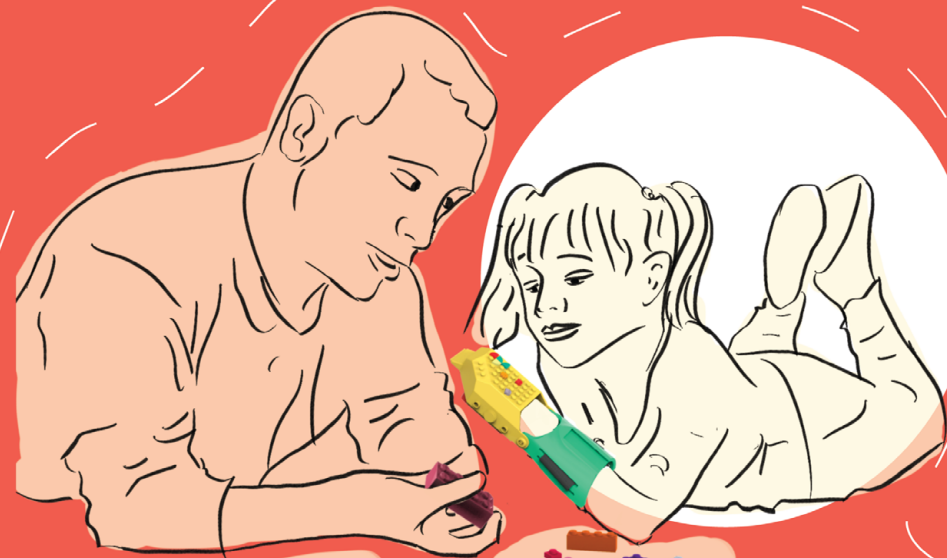
or



attacing jumping  
rope to jump

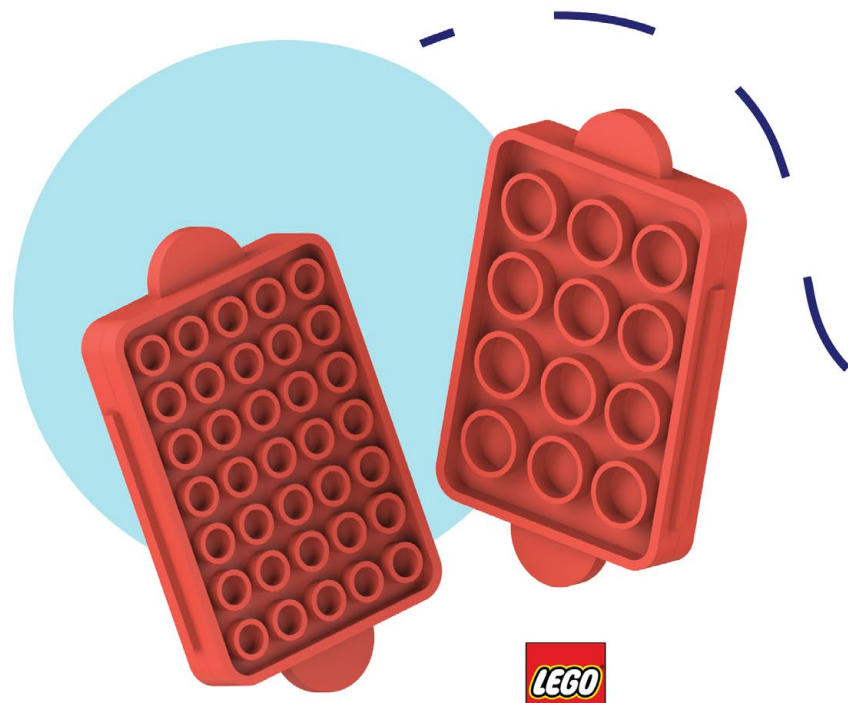


picking up lego bricks





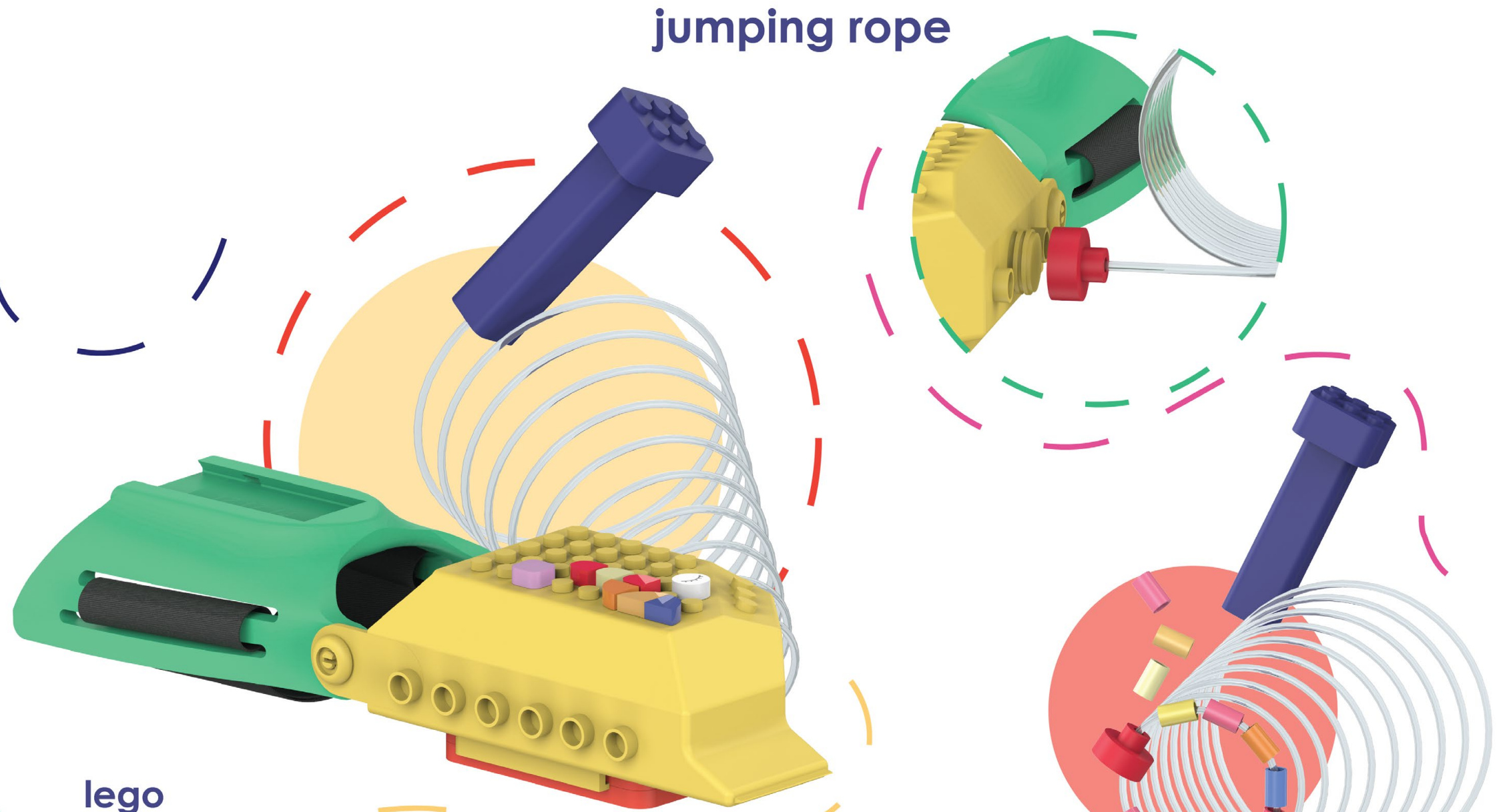
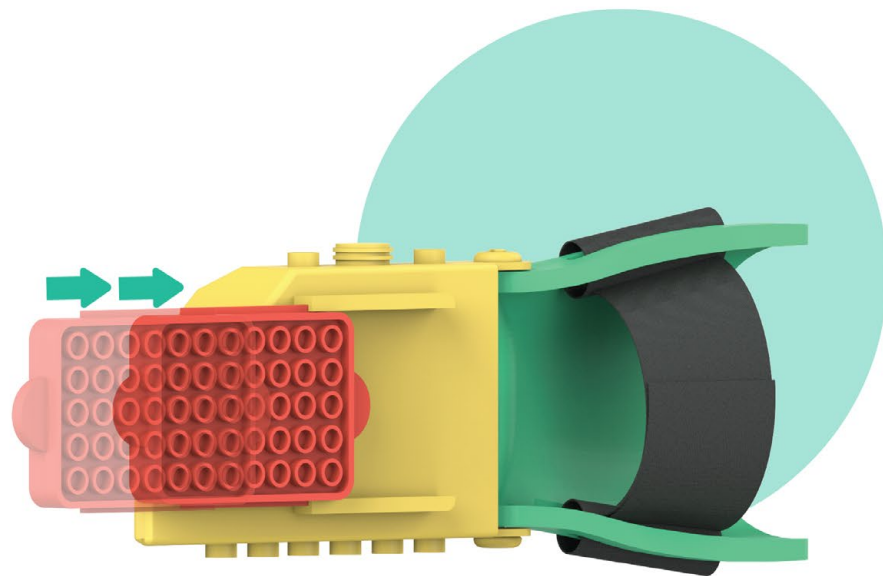
# DETAILS LEGO PLAY



LEGO  
CLASSIC

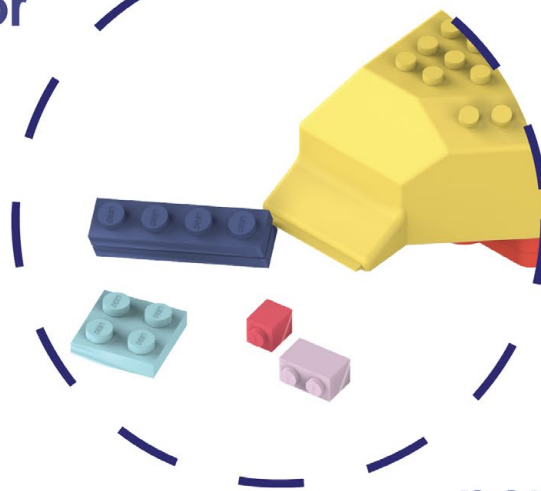
LEGO  
duplo

lego brick holder

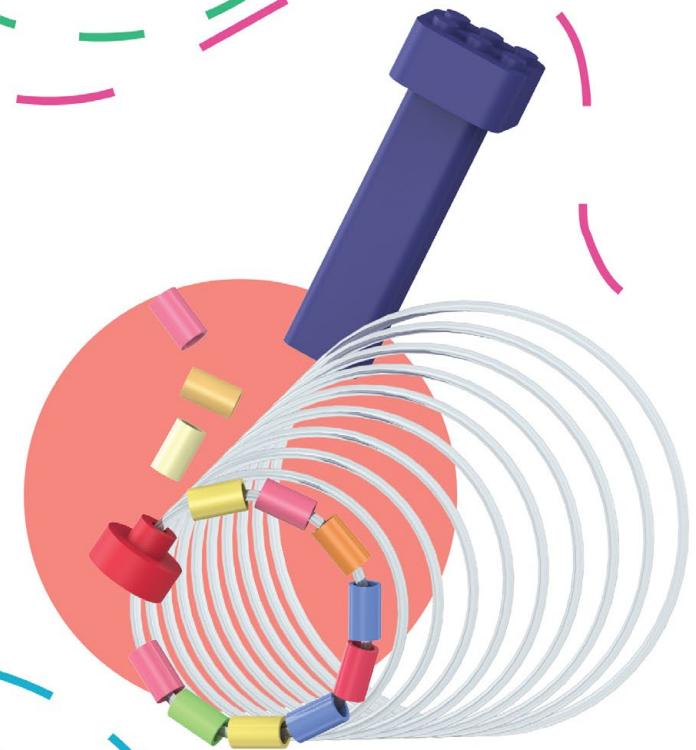
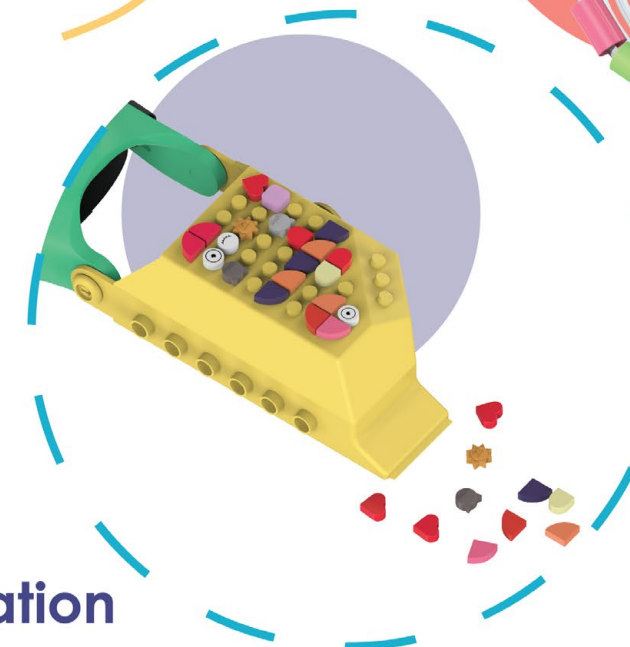


jumping rope

lego  
brick  
separator



personalization







Designer / Tasarımcı  
Elif Tunca

# PEN FINGERS

3D printed mechanical hand design with adjustable fingers to make writing easier for kids with limb differences.

*Uzuv farklılıkları olan çocukların yazı yazmalarını kolaylaştıran ayarlanabilir parmaklı 3B baskı mekanik el.*

**Pen Finger aims to help children who suffer from limb loss. In the current models, the fingers can not always maintain a fixed position due to the wrist or elbow-focused grip movement. In order to help children write again Pen Finger has adjustable finger mechanism and a rail system to adjust to any pen attached.**

*Pen Finger uzuv kaybı yaşayan çocuklara yardım etmeyi amaçlar. Mevcut modellerde bilek veya dirsek odaklı kavrama hareketinden dolayı parmaklar her zaman sabit bir pozisyonu koruyamamaktadır. Çocukların tekrar yazı yazabilmesine yardım etmek için Pen Fingers'ın ayarlanabilir parmak mekanizması ve herhangi bir kaleme uyum sağlaması için raylı bir sistemi vardır.*



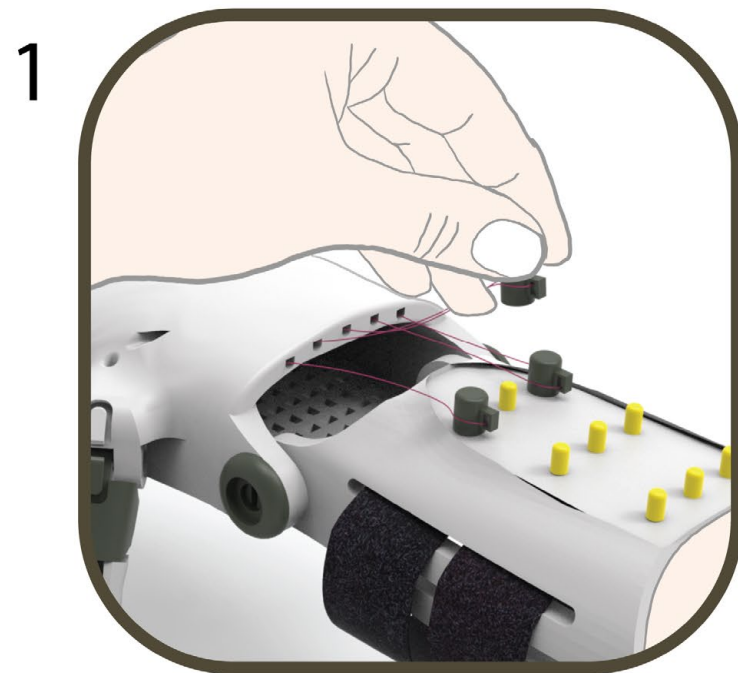
# PEN FINGERS



Adjustable Pen Fingers make writing easier for amputee Kids



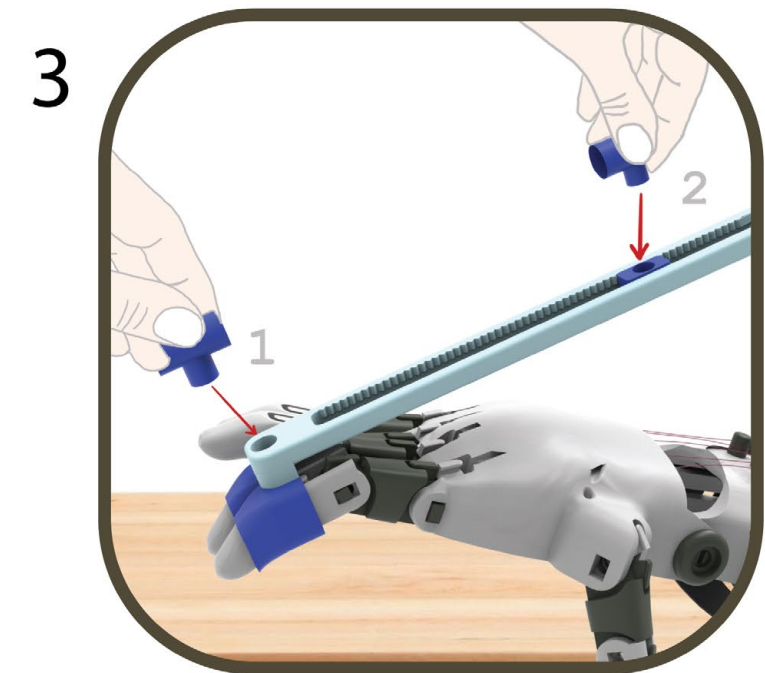
# SCENARIO PEN FINGERS



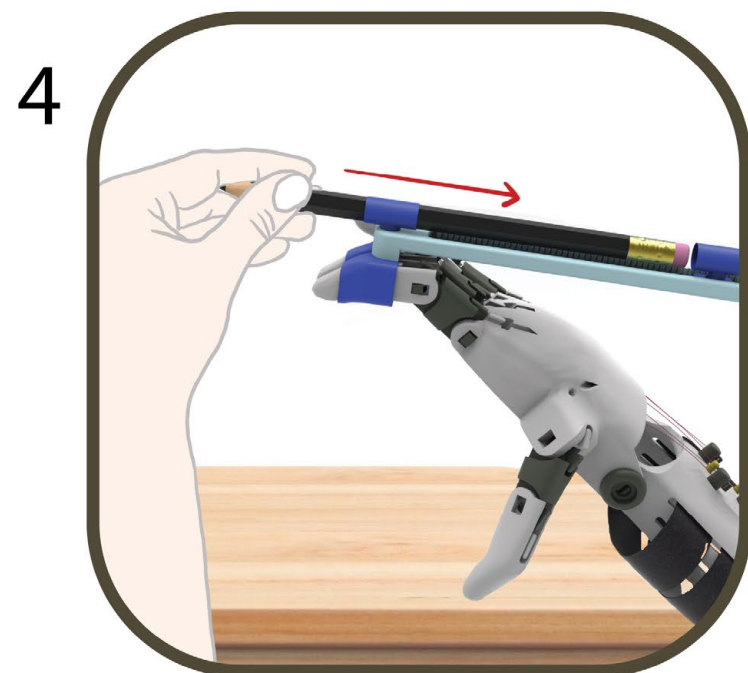
Rope setting



Placing the finger attachment



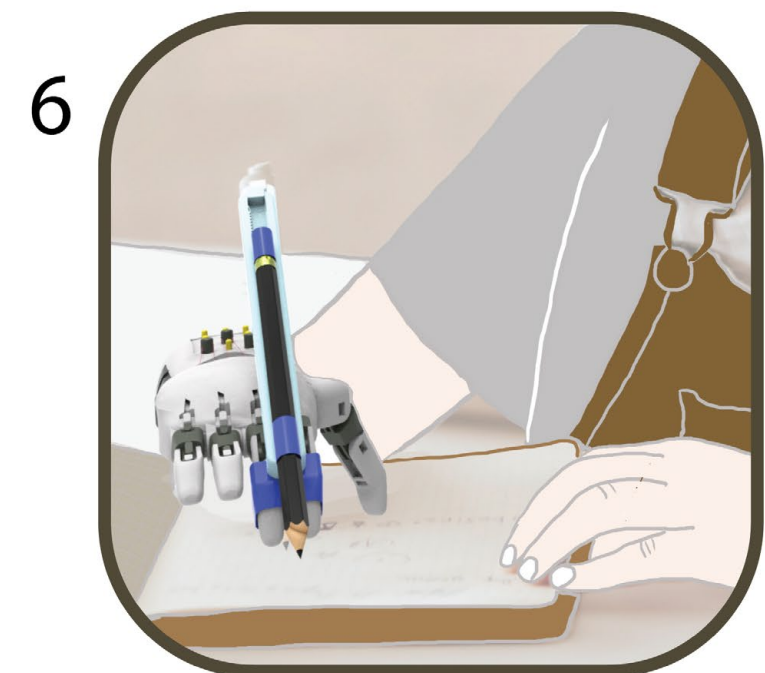
Placing the pen parts



Placing the pen



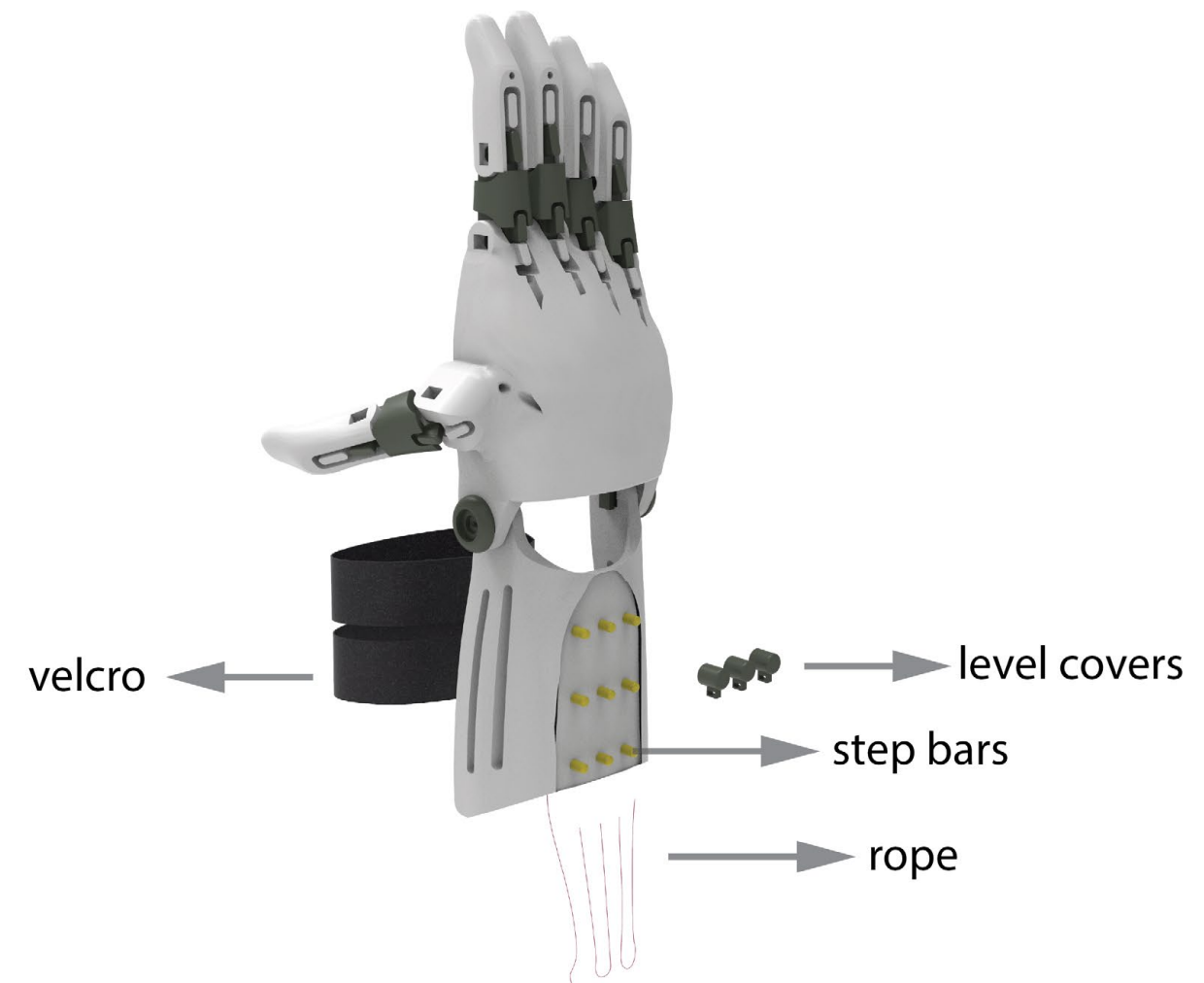
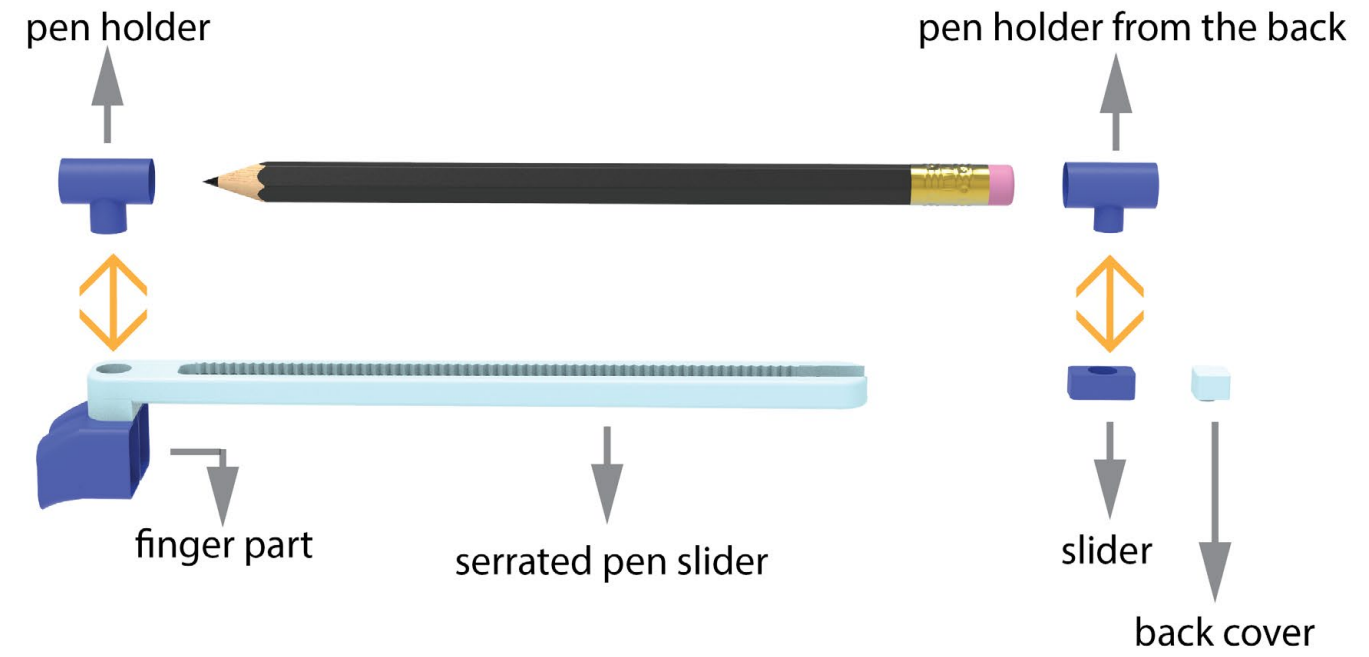
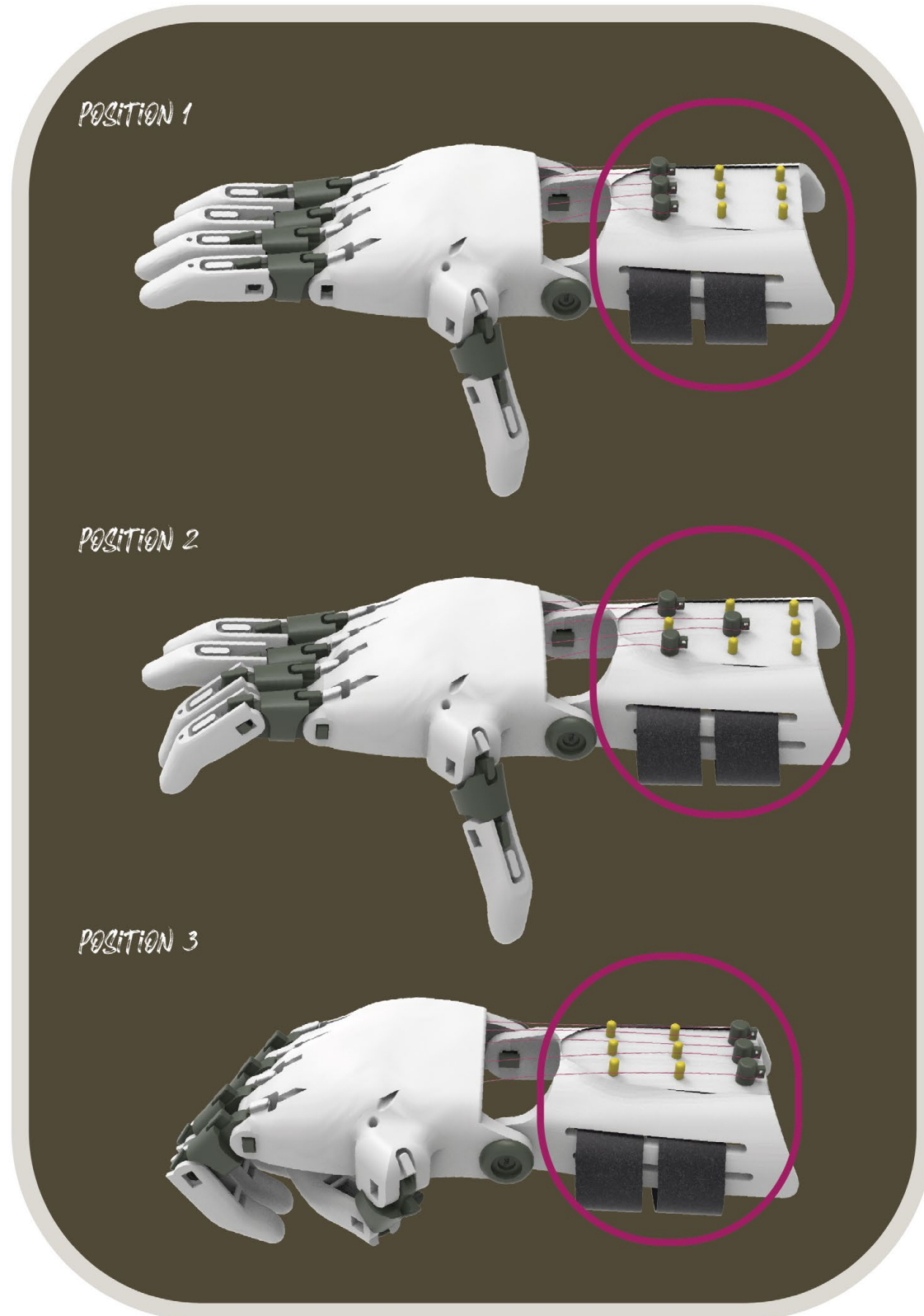
Adjusting for the pen size



Writing



# DETAILS PEN FINGERS







Designer / Tasarımcı  
İlay Keskin

# HOLDER

Specialized mechanical hand and apparatus design to hold the phone steady and position it at an angle that can be used comfortably.

*Telefonu sabit tutmak ve rahat kullanılabilecek açıda konumlandırmak için özelleşmiş mekanik el ve aparat tasarımı.*

Holder aims to help children with limb differences to comfortably hold and use their phones. They struggle to grip and use the phone in the current model due to having limited movement. This device is attached to the mechanic hand using a simple locking mechanism, adjusted to the desired angle, and is simple to insert and remove due to the magnet.

*Holder, uzuv farklılığı olan çocuklara telefonu sabit tutabilmeleri ve rahat kullanabilmeleri için yardımcı olmayı hedeflemektedir. Mevcut modellerin sınırlı miktarda harekete izin vermesi yüzünden telefonu tutmada ve kullanmada zorluk çekiyorlar. Mekanik ele basit bir kilit sistemiyle yerleşen bu aparat, istenilen açıda ayarlanıyor ve mıknatıs sayesinde rahatça takılıp çıkarılabilmektedir.*



# HOLDER

Holder aim to keep the phone stable in the palm with magnet.





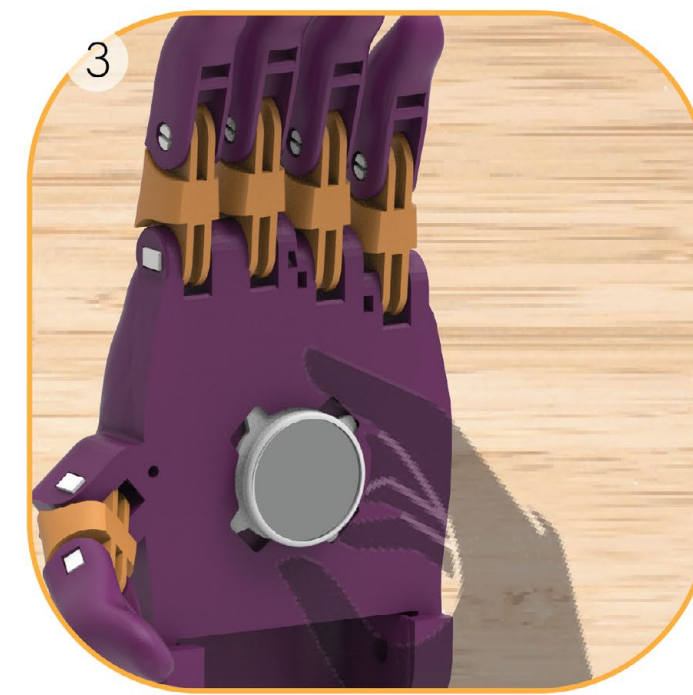
# SCENARIO HOLDER



holder's place in the palm



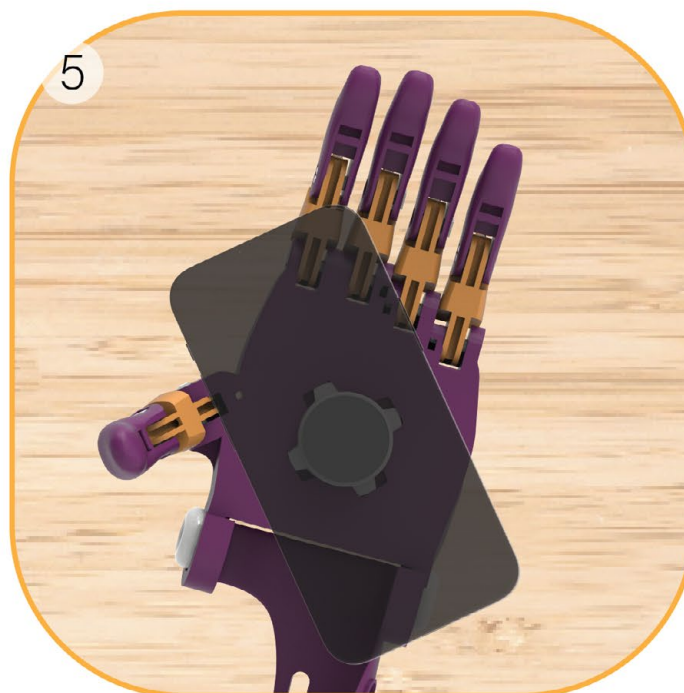
placing holder in the palm



turn and lock the holder



holder - sticker on the back of the phone



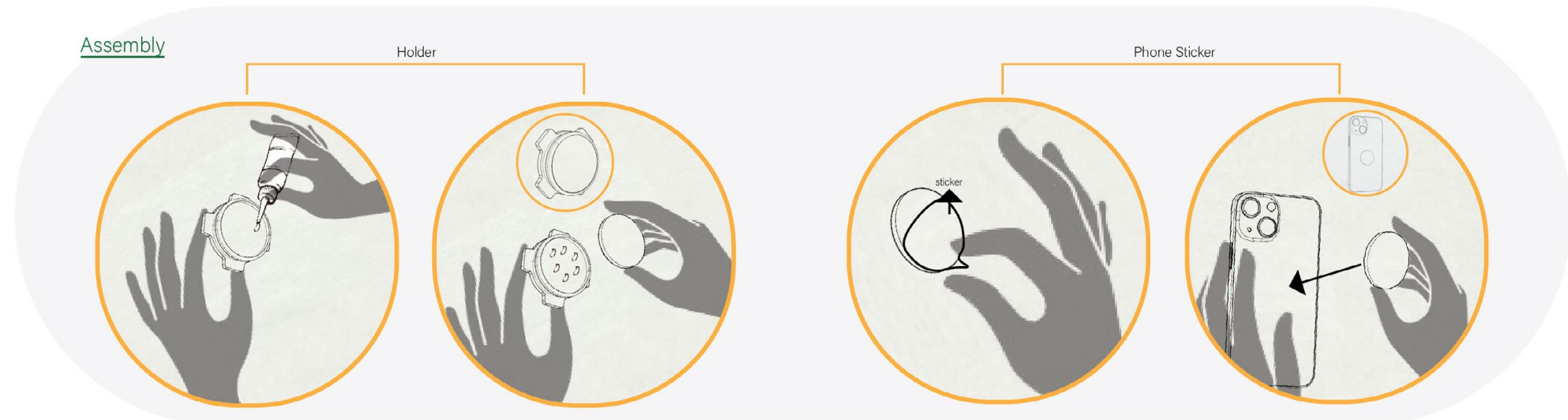
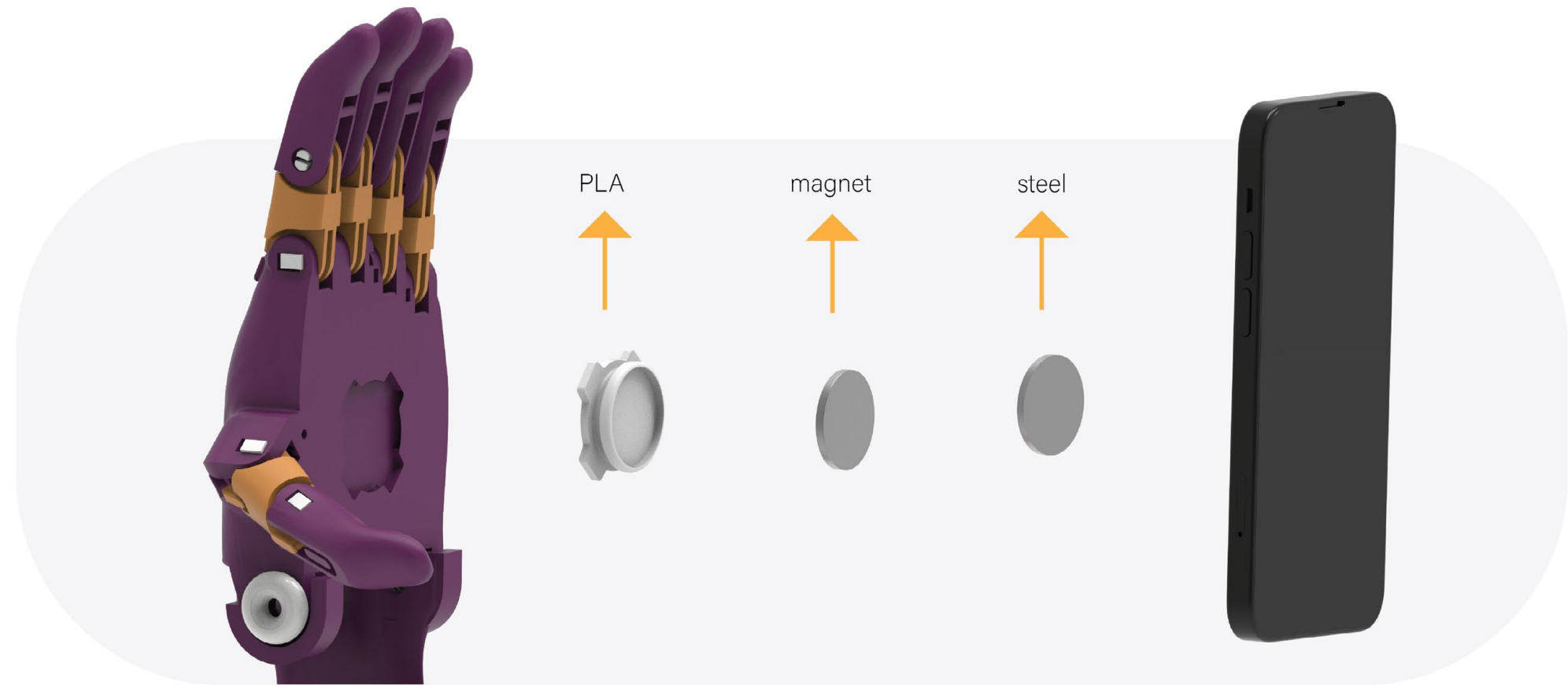
places the phone in the holder



turn and unlock the holder



# DETAILS HOLDER







**Designer / Tasarımcı**  
İlayda Yaşa

# SUNSET

3D printed set that offers different attachments for swimming, playing with the sand and ball at the beach.

*Yüzme, kumla ve plaj topuyla oynamak için 3B baskı ek parça seti.*

**Sunset is a 3D-Printed beach set that offers 4 different attachments for swimming, playing with the sand and the ball. The attachments aim to strenghten muscles by motivating to move the child at the beach. Once the attachments are plugged in, it is possible to play with them immediately.**

*Sunset, yüzmek, kumla oynamak ve topla oynamak için 4 farklı aksesuar sunan bir plaj setidir. Aksesuarlar çocuğu kumsalda hareket ettirmek için motive ederek kasları güçlendirmeyi amaçlar. Aksuarlar takıldığı an oynanmaya hazır hale gelir.*



# SunSet.

SunSet is a 3D printed set offers four different attachments for swimming, playing with the sand and ball at the beach.





# SCENARIO SUNSET

## Harrow

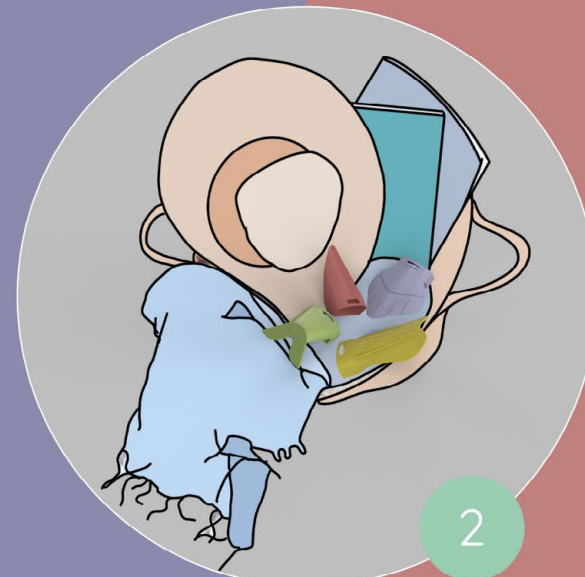
All four attachment aims to strengthen muscles by motivating to move the child at the beach.

The product is made out of 3D printed PP to increase resistance to sea salt and water.



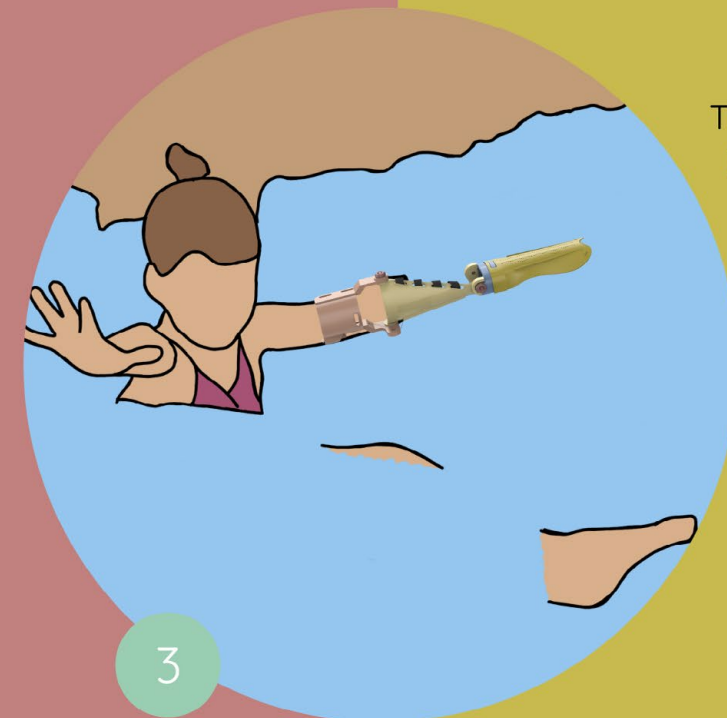
She wears her Sunset arm before coming to the beach.

## Ball Catcher



The Sunset attachments are carried in the beach bag.

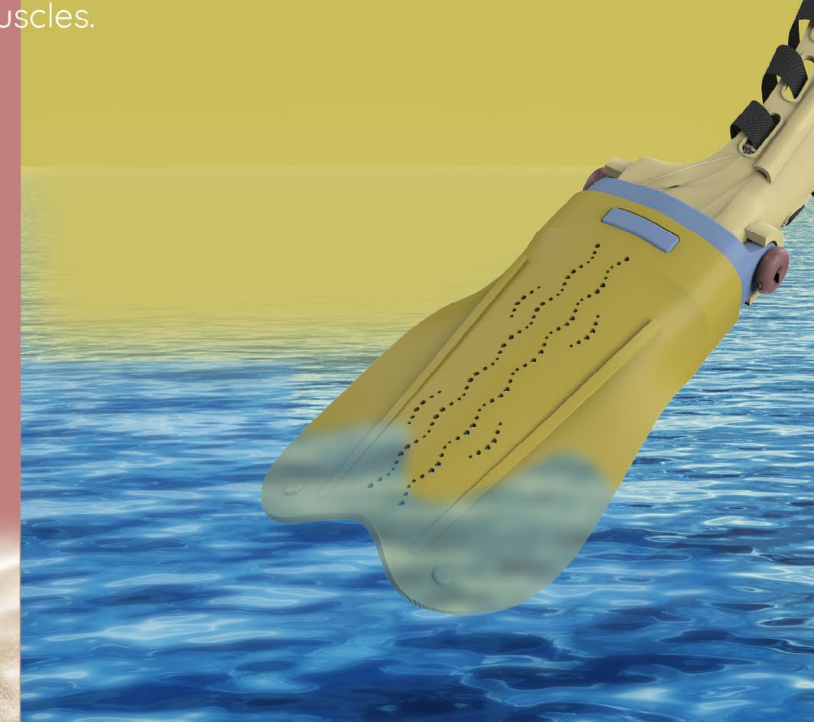
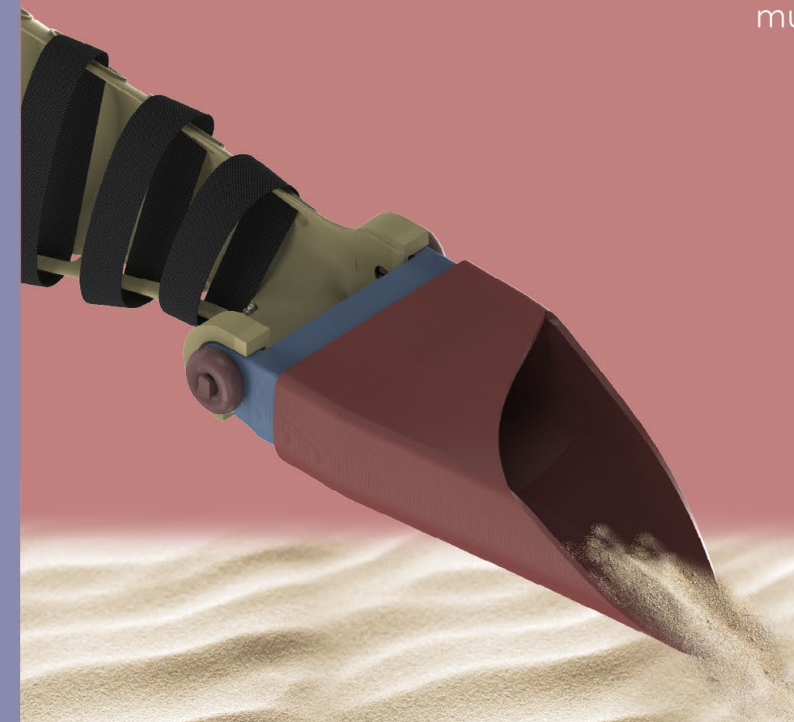
## Shovel



She attaches one of the attachments according to activity. She starts to have fun as well as strengthen her muscles.

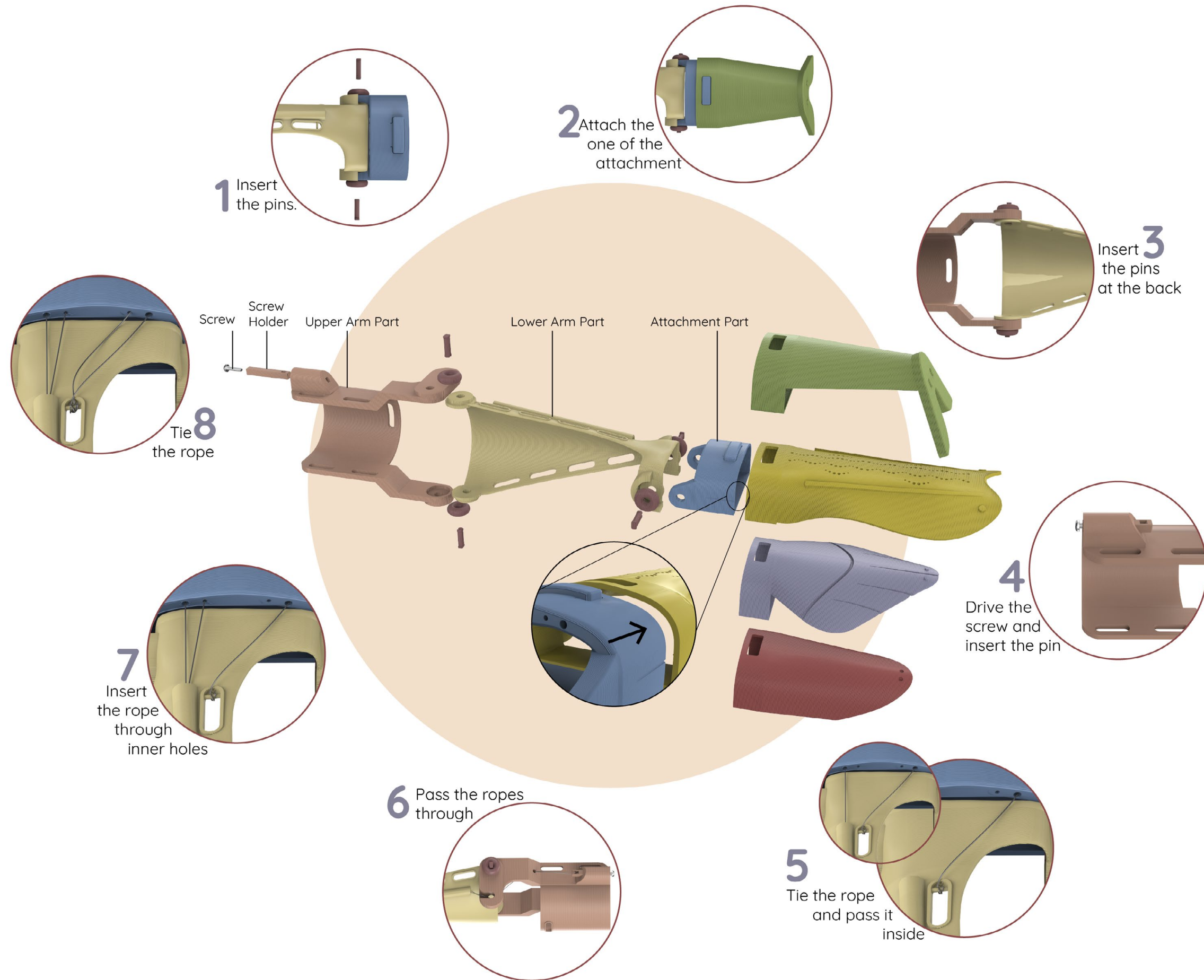
## Swimming Padel

The attachments can be plugged in conveniently and played immediately by children.





# DETAILS SUNSET







Designer / Tasarımcı  
İrem Öcal

# VOICE

**Voice is a 3D printed musical instrument set designed to develop children's rhythmic abilities.**

*Voice, çocukların ritim becerilerini geliştirmek için tasarlanmış 3D basılmış bir müzik aleti setidir.*

**Voice is a set with three different accessories and a mechanical hand designed for children with limb loss. This set consists of a shaker, an accessory for percussion instruments and a tambourine with a bell. These accessories, which can be easily attached to the mechanical hand, allow children to have a pleasant time with their families and friends while improving their rhythm abilities.**

*Voice, uzuv kaybı yaşayan çocuklar için tasarlanmış üç farklı aksesuar ve mekanik bir ele sahip olan bir settir. Bu set bir shaker, vurmali çalgılar için bir aksesuar ve zilli bir teften oluşur. Mekanik ele kolayca takılabilen bu aksesuarlar, çocukların ritim yeteneklerini geliştirirken aileleri ve arkadaşları ile keyifli vakit geçirmelerini sağlar.*



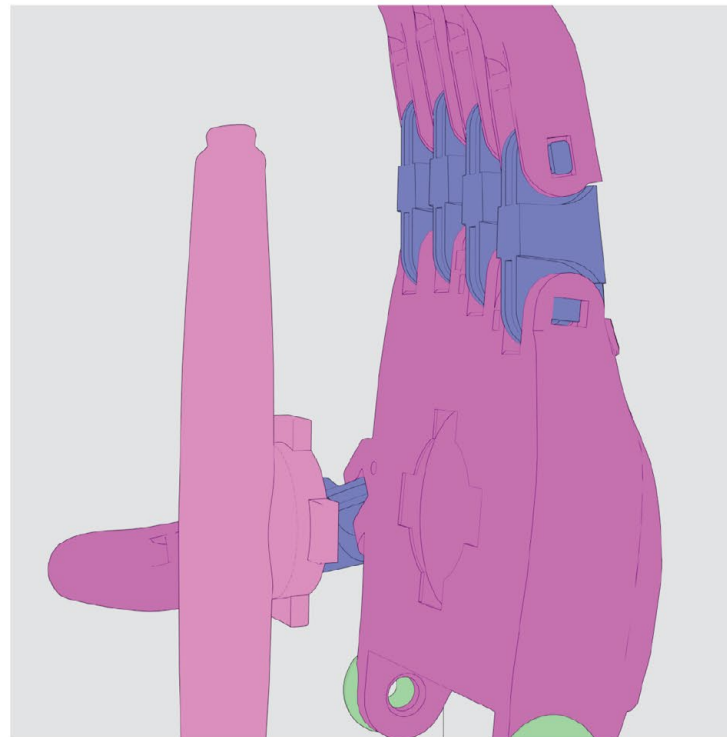




# SCENARIO VOICE



Mechanical Hand and Accessories



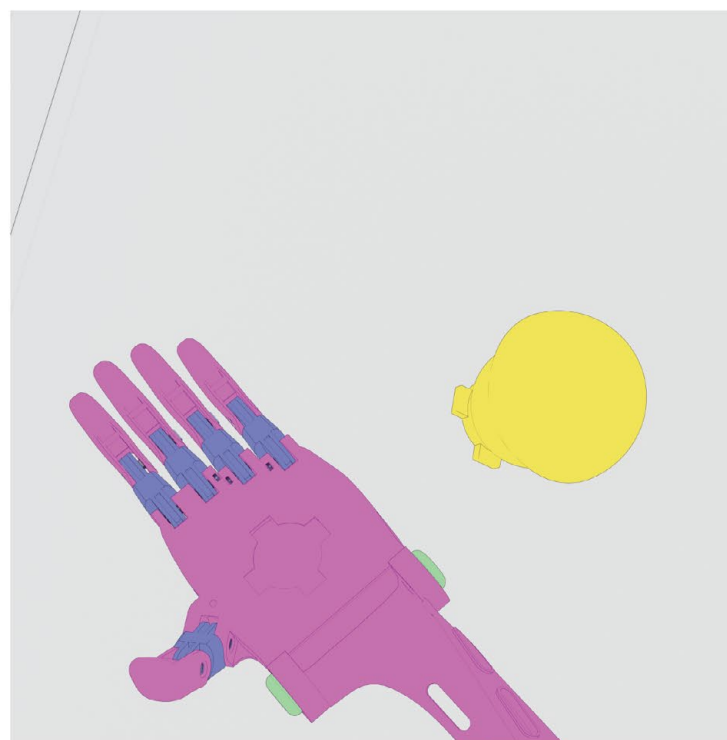
It is attached to the palm.



The accessory is rotated and locked in the palm.



She can develop the sense of rhythm with musical instruments.



She can easily change accessories.



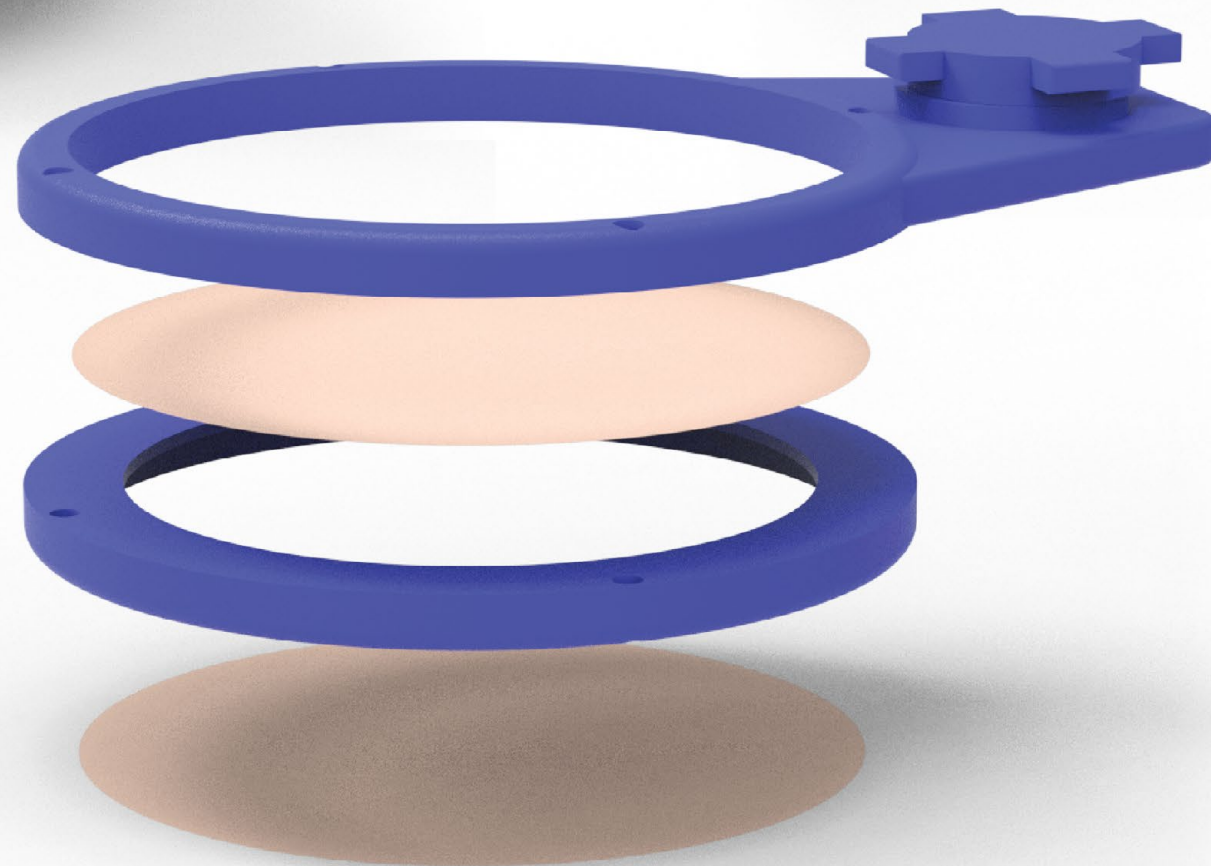
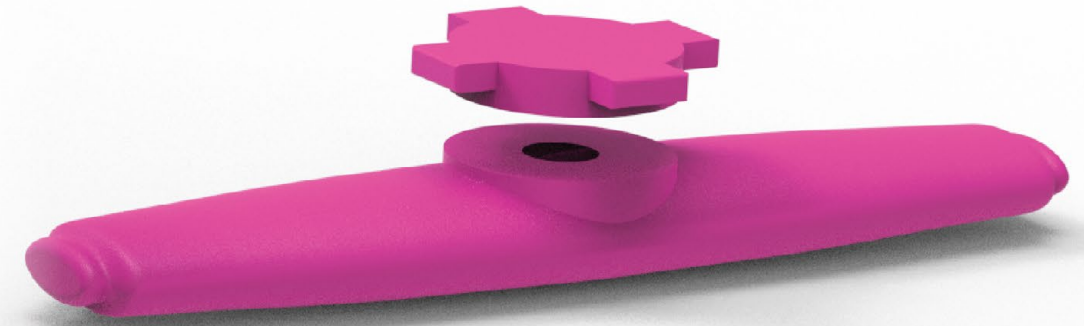
Also, she can start having a good time with her friends.



# DETAILS VOICE

## Exploded View

- Materials of products is ABS
- Production method is 3D printing
- Components join with glue







**Designer / Tasarımcı**  
Kaan Kıyıcı

# BUZZER BEATER

The 3D-printed mechanical hand is tendon-driven and enables kids missing a hand to grasp, dribble, and shoot a basketball.

*3B baskı mekanik el tendon prensibiyle çalışır ve bir eli olmayan çocukların basketbolu kavramasını, top sürmesini ve şut atmasını sağlar.*

**Buzzer Beater helps children with limb differences use the ball as a grasping, throwing, and supporting hand while playing basketball. Existing models did not have tendon work for closing and opening the fingers. Buzzer Beater provides the ability of movements suitable for basketball playing.**

*Buzzer Beater, uzuv farklılıkları olan çocukların basketbol oynarken topu kavrama, fırlatma ve destek eli olarak kullanmalarına yardımcı olur. Mevcut modellerde parmakları açıp kapamak için tendon çalışması yoktur. Buzzer Beater basketbol oynamaya uygun hareket kabiliyeti sağlar.*



# **BUZZER** **BEATER**

PROSTHETICS

The 3D-printed prosthetic hand is tendon-driven and enables kids missing a hand to grasp, dribble, and shoot a basketball.





# SCENARIO BUZZER BEATER



**1** The child places the prosthetic on the hand before playing basketball.

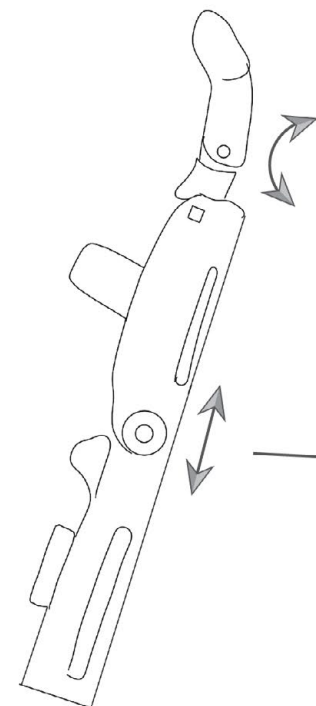
**2** They go to the court with the prosthetic basketball hand they wear on their hands, mainly basic movements

**3** It takes the power from Buzzer Beater while throwing the ball. It functions as a side support hand.

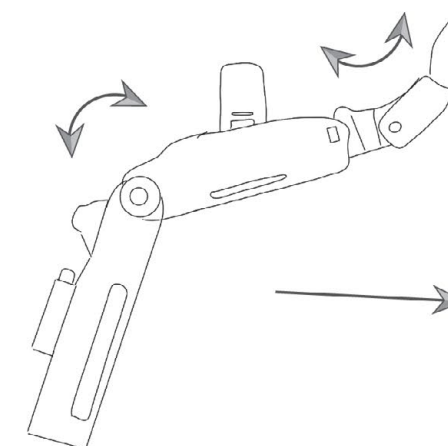
**4** The ball is out of the hand and the fingers are open.



I applied a 3-fingered and diagonal design approach to better absorb the grip and the incoming impact.



The fingers are straight when the ball is out of the hand or when the wrist is not bent.

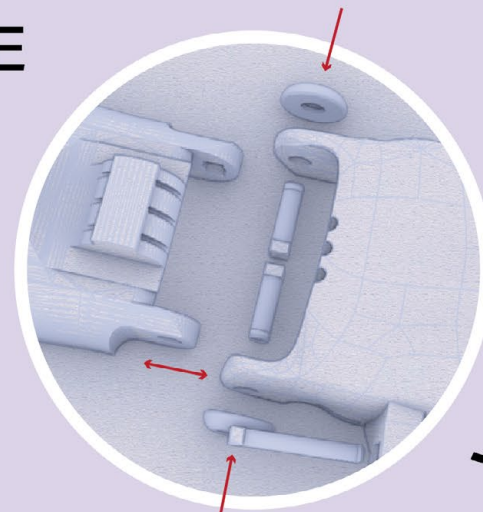


With the fishing line logic, only the reversely bent fingers are closed, as the wrist is bent, the fingers grasp the ball better.



# DETAILS BUZZER BEATER

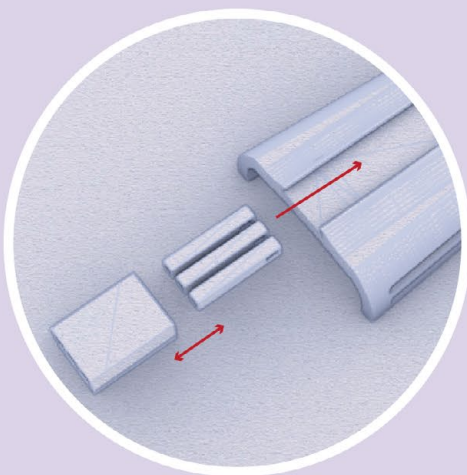
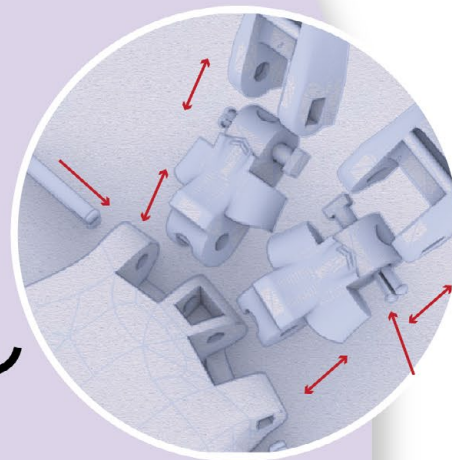
## ASSEMBLY OF THE HAND



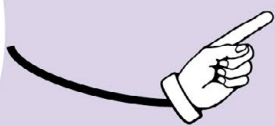
Hinge pins and Hinge caps are connected together.



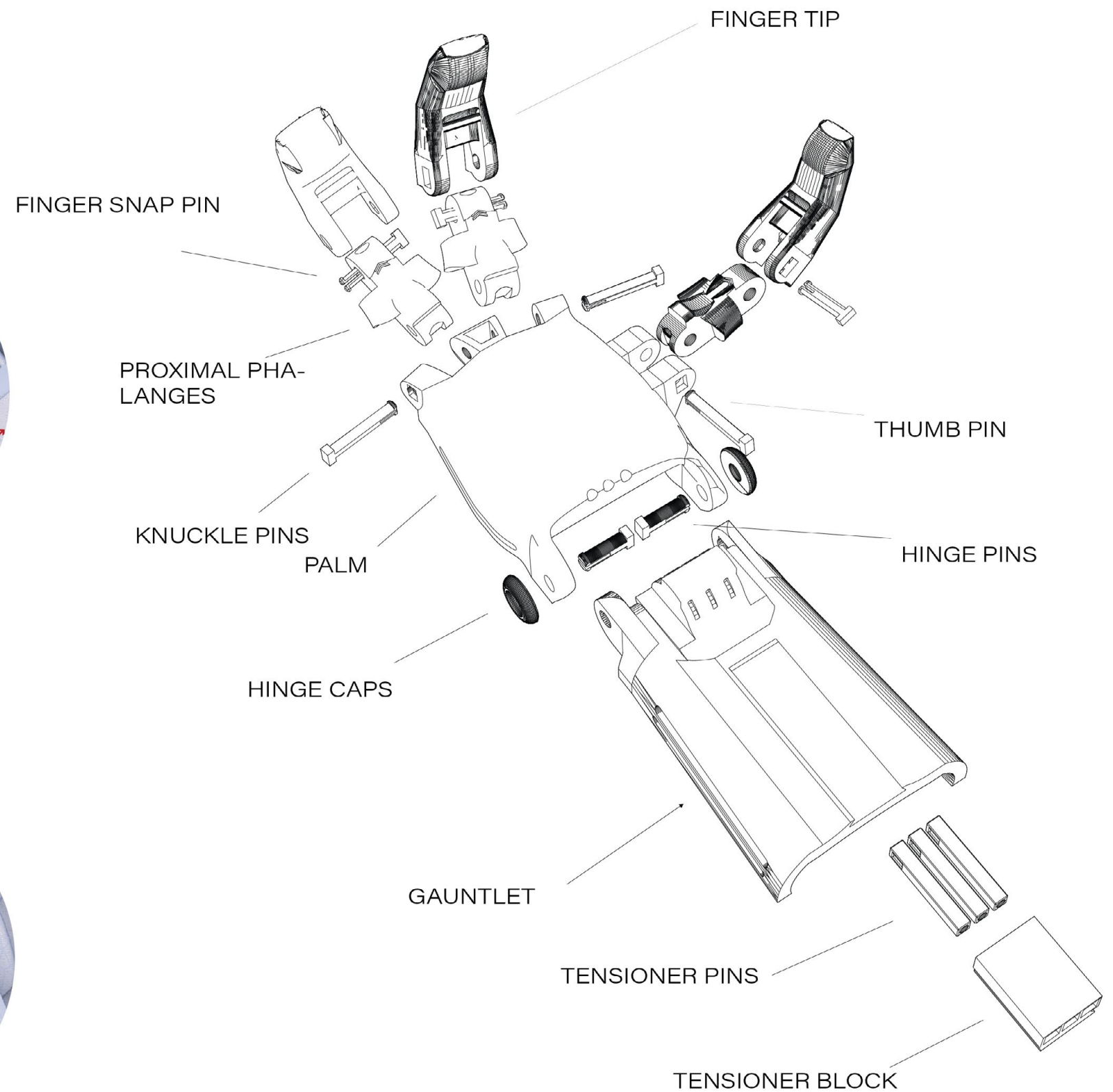
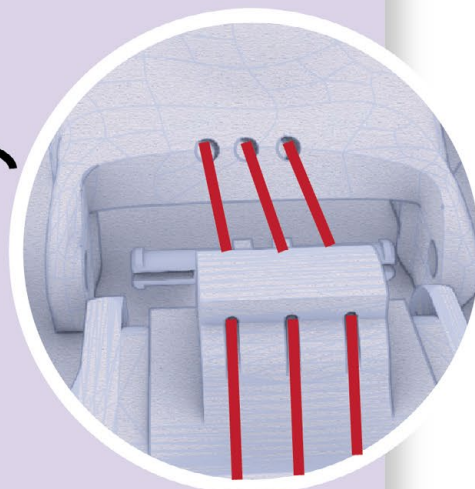
Fingers and joints are connected to each other. It is then joined with the palm.



Tension block and tension pins are intertwined and fixed to the point where the rope will stay taut by sliding.



Finally, the threads are passed through the holes and the velcro is passed through the holes on the side surfaces and the assembly is completed.







**Designer / Tasarımcı**  
Sedef Şara Baydar

# UP AND BALL

A 3D printed arm above the elbow with improved features for playing volleyball.

*Voleybol oynayabilmek üzerine özellikleri geliştirilmiş dirsek üstü 3B baskı kol.*

**Up and Ball is a 3D printed mechanical arm developed for children who want to learn and play volleyball. Impact zones are supported by silicone and PVC leather. For durability and strength the lower arm consists of only one piece and is a closed form. With movements made from the elbow, the user can demonstrate basic volleyball movements.**

*Up and Ball voleybol öğrenmek ve oynamak isteyen çocuklar için geliştirilmiş bir üç boyutlu çıktı ile üretilen mekanik bir koldur. Topun çarptığı bölgeler silikon ve PVC deri ile destekleniyor. Dayanıklılık ve sağlamlık için alt kol tek parçadan oluşup kapalı bir forma sahiptir. Dirsekten yapılan hareketlerle kullanıcı temel voleybol hareketlerini sergileyebilir.*



# UP AND BALL

Unlimbited Arm





# SCENARIO UP AND BALL

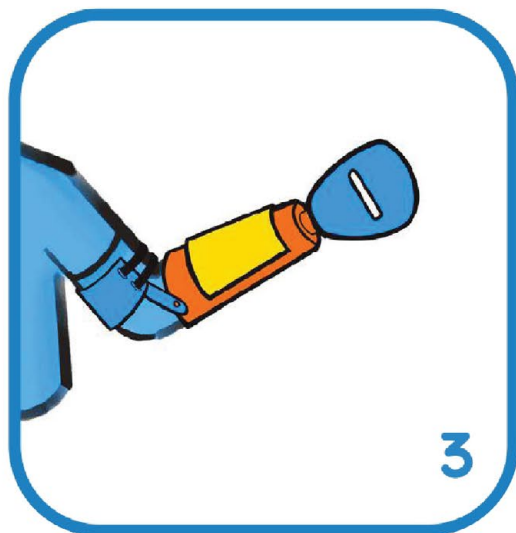
He loses his balance,



And can't receive balls.



Up and Ball is a modified unlimbited arm for the kids who likes to play volleyball!



After getting Up and Ball,



He performs basic moves.



Starts to keep his balance.



And enjoy volleyball!



# DETAILS UP AND BALL



Bump



Hold



Set



Serve

Hand and arm is connected by an intermediary part.



1



2

Leather is glued on.

The part for elbow movement is heated and shaped.



3

After that, pins are placed from the inside of the arm.



4

Velcro and evo foam are placed.





Designer / Tasarımcı  
Tuana Kaynar

# MELMAN

Melman is an accessory to facilitate kids' two-handed food consumption activities in outdoor environments.

*Melman uzuv farklılığı olan çocukların dış mekanlarda iki ellerini kullanmaları gereken yeme içme aktivitelerini kolaylaştıran bir aksesuardır.*

**Kids who have limb differences struggle with eating and drinking experiences. Especially outside, it's challenging to use the two-handed practice and to find a flat surface to put supplies. By its spring mechanism, Melman can hold variety of bowls and beverages by compressing them from the edges.**

*Uzuv farklılığı olan çocuklar gündelik yeme içme deneyimlerinde zorlanıyorlar, özellikle iki elin de sık kullanıldığı ve düz bir zemin bulmanın zor olduğu dış mekanlarda. Melman'ın içinde bulunan yaylı sistem sayesinde çocuklar bu şekilde birçok içecek ve kâseyi kenarlarından sıkıştırarak tutabiliyor.*



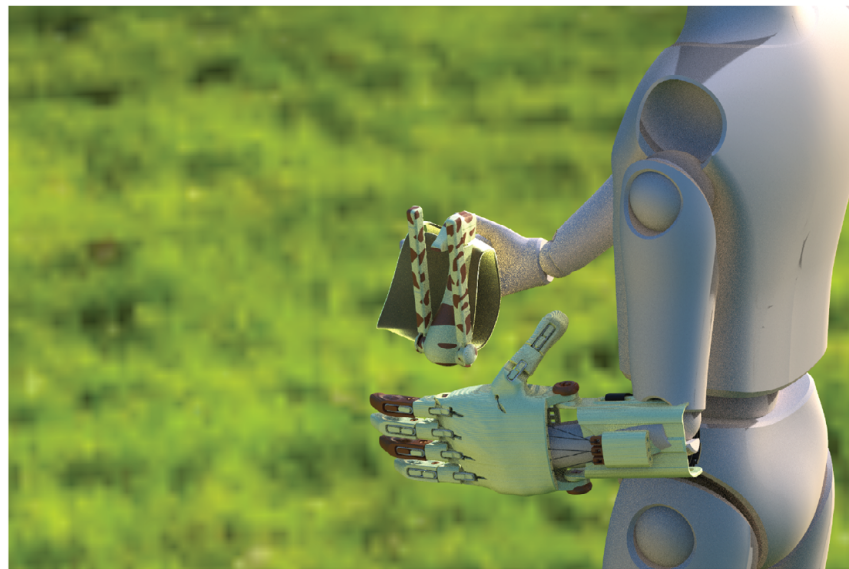
# MELMAN

Melman is a giraffe shaped beverage or bowl holder to **enhance** kids' **eating and drinking experiences.**

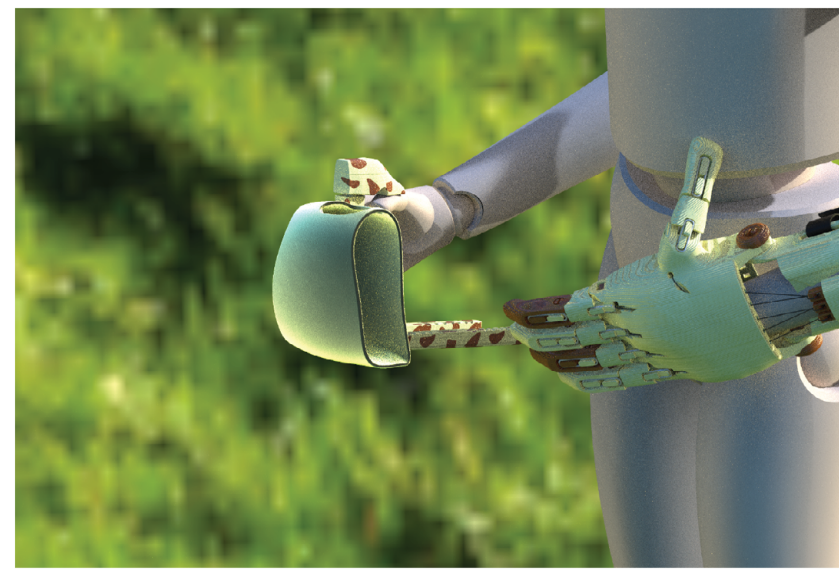




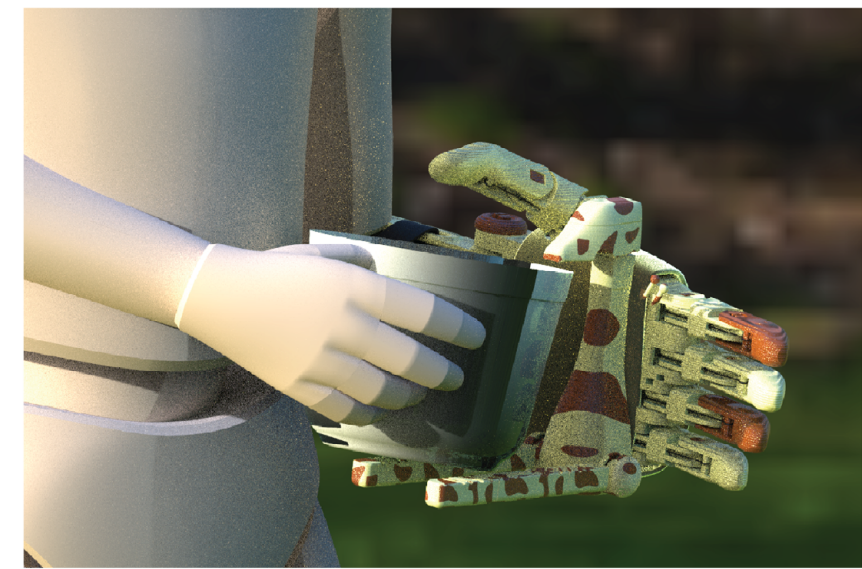
# SCENARIO MELMAN



User takes out the Melman in folded view.



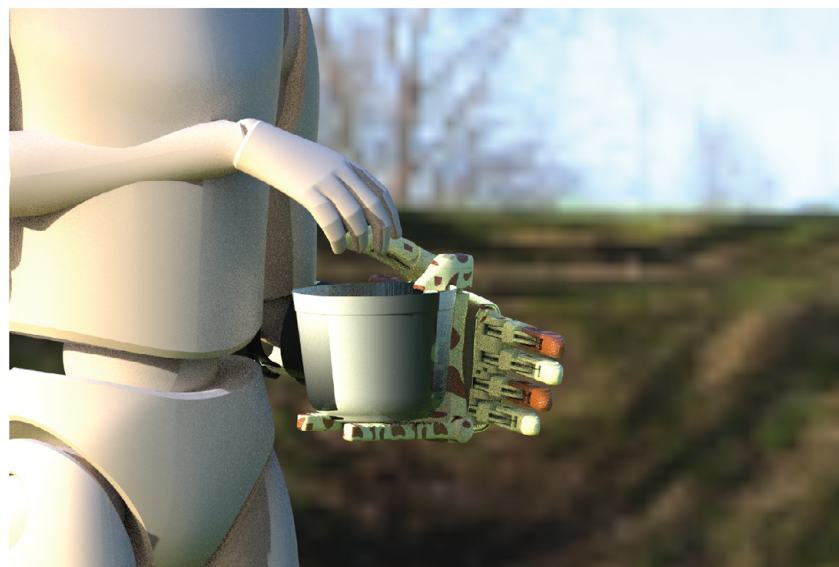
User unfolds the legs to create the surface for holding.



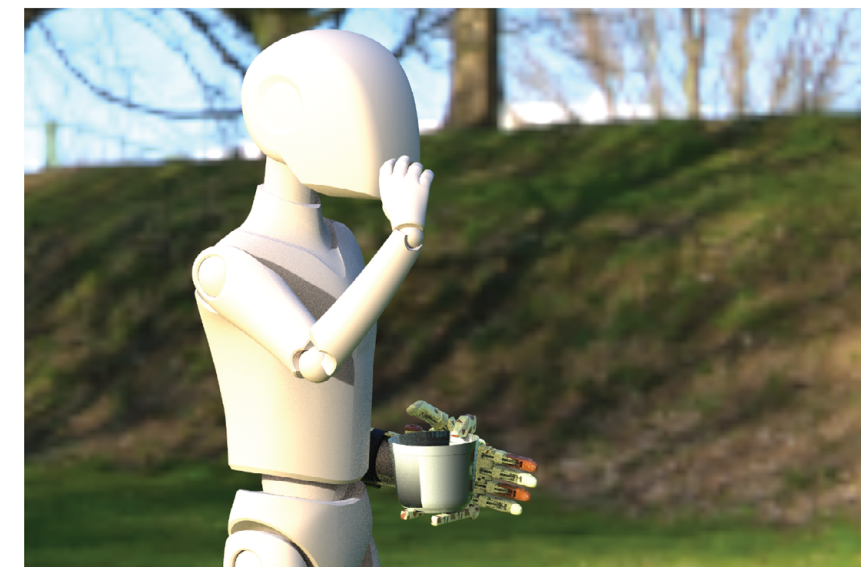
User puts the bowl on the area.



The section of the bowl sticks in the hole, head compresses it.



User can carry the bowl while using their dominant hand to eat.



User can always use Melman when they need to use their other hand to eat.



# DETAILS MELMAN



## COMPRESSING.

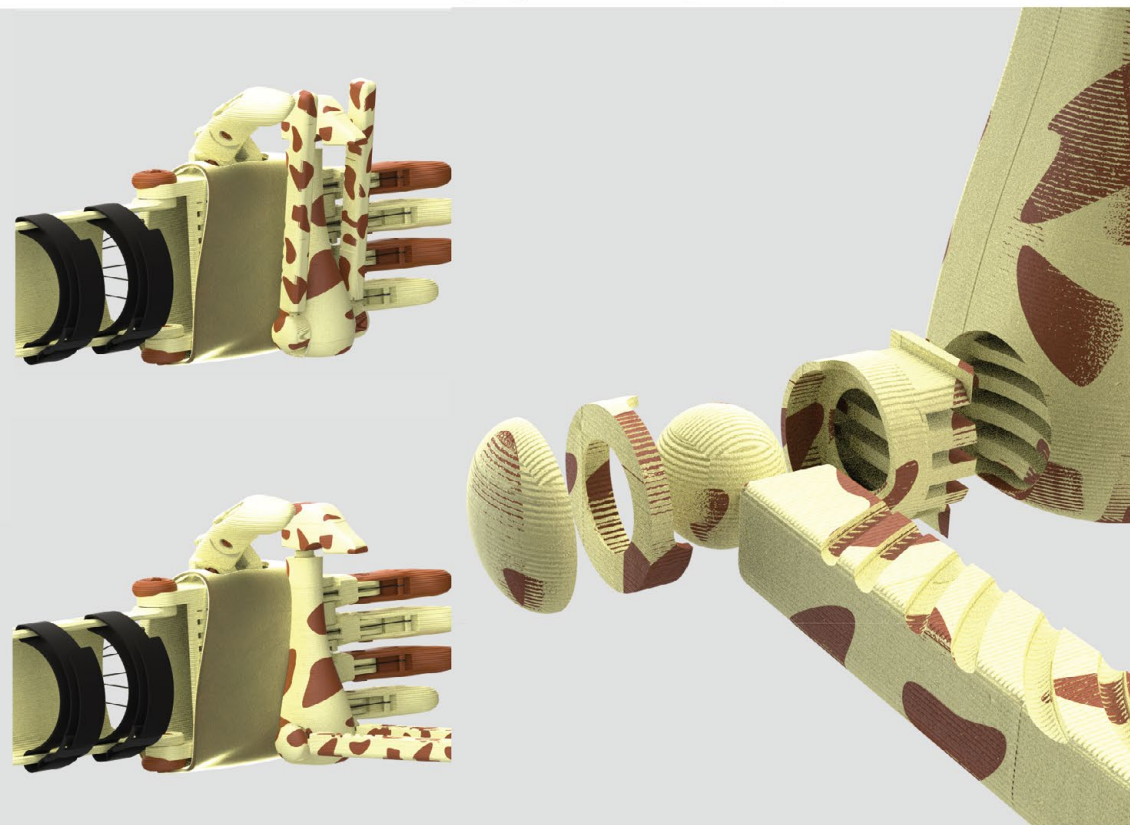


Spring and bump at the end of the neck compresses the material.



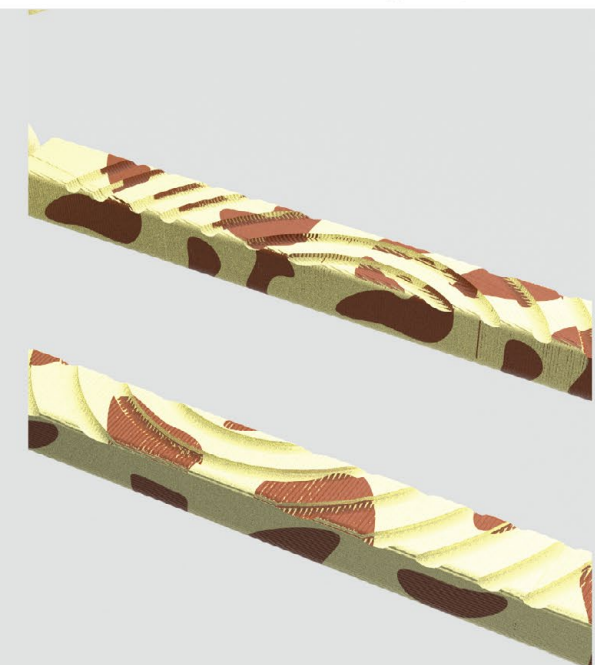
Head piece can compress both for surfaces that are closed or opened.

## ARTICULATION.



Couple of socket joints provides the 90 degree articulation movement.

## BALANCE.



The wavy pattern on the legs determines the center and balances the cup/bowl.





Designer / Tasarımcı  
Umut Seval

# CREATIVITY

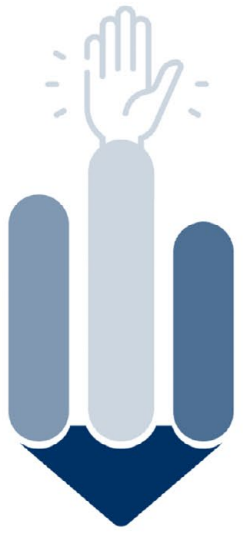
Creativity mechanical hand is designed for children who do not have two hands which helps them draw and paint.

*Creativity mekanik el, iki eli olmayan çocuklar için çizim ve resim yapmalarına yardımcı olmak amacıyla tasarlanmıştır.*

These attachments for children are designed for those who do not have two hands and cannot draw. We know that children reinforce their imagination with painting. By designing the inserts in two different sizes and adding a small stretch, I made it possible to match them with different pens.

*Çocuklara yönelik bu eklentiler, iki eli olmayan ve çizim yapamayan kişiler için tasarlanmıştır. Çocukların hayal güçlerini resim yaparak pekiştirdiklerini biliyoruz. Uçları iki farklı boyutta tasarlayarak ve küçük bir streç ekleyerek farklı kalemlerle eşleştirmeyi mümkün kıldım.*





**CREATIVITY**  
for unlimbited users



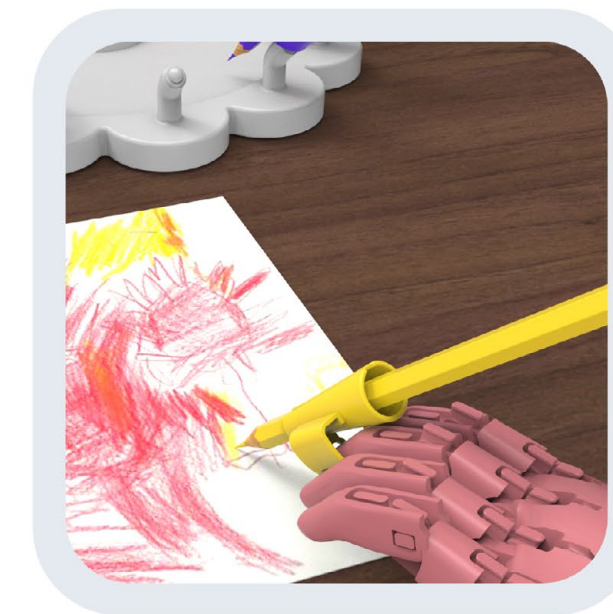


# SCENARIO CREATIVITY



**1** Parents put pencil to the attachment and place it to the stand.

**2** The child takes the pencil from stand.



**3** The child starts to drawing.

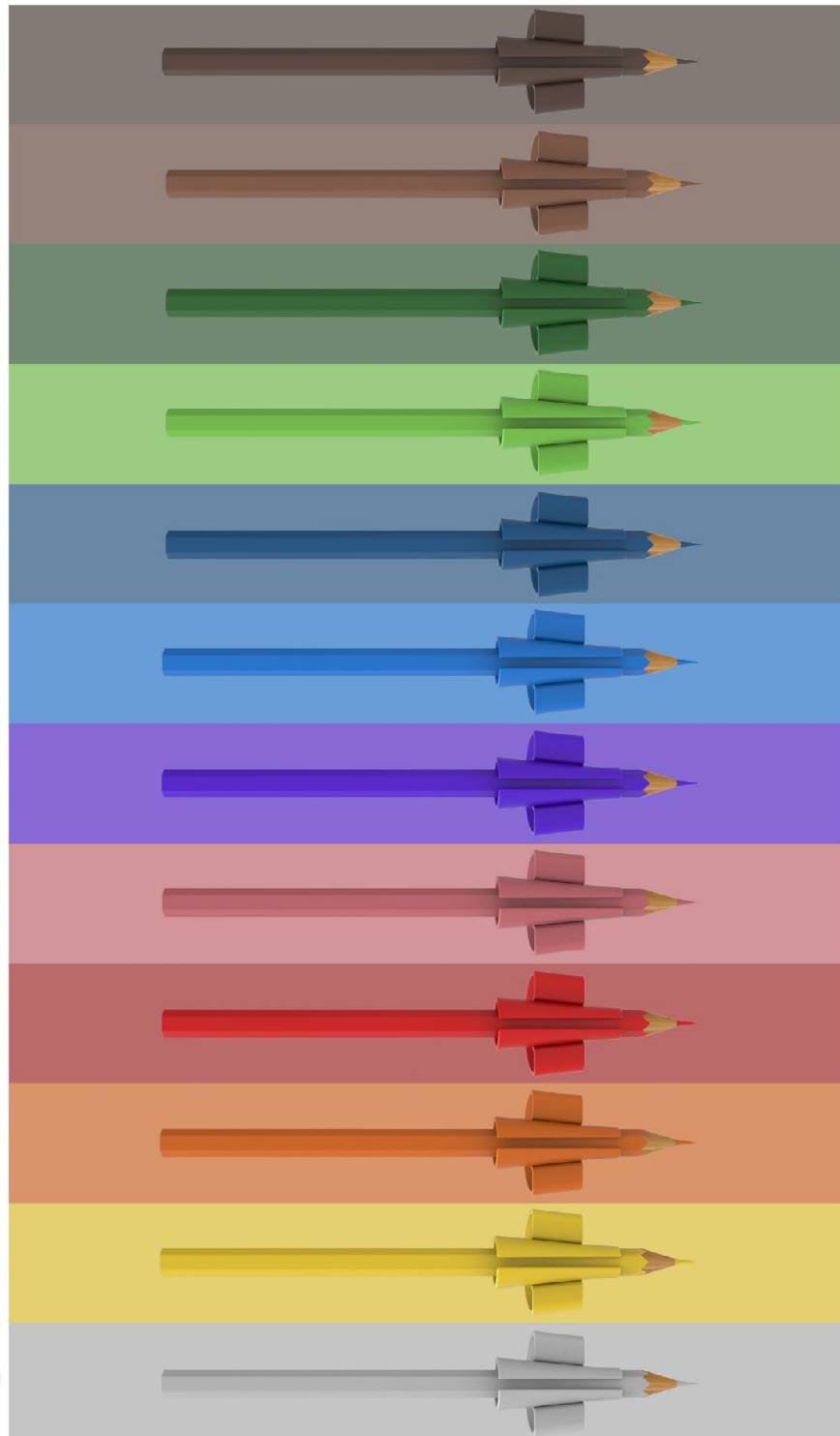
**4** The child changes the pencil for different colour.





# DETAILS CREATIVITY

## Colour Alternatives



### Size 1

7-8 mm  
Dry Coloring Pencils  
Felt-Tip Pens  
Roller Pens  
Brushes



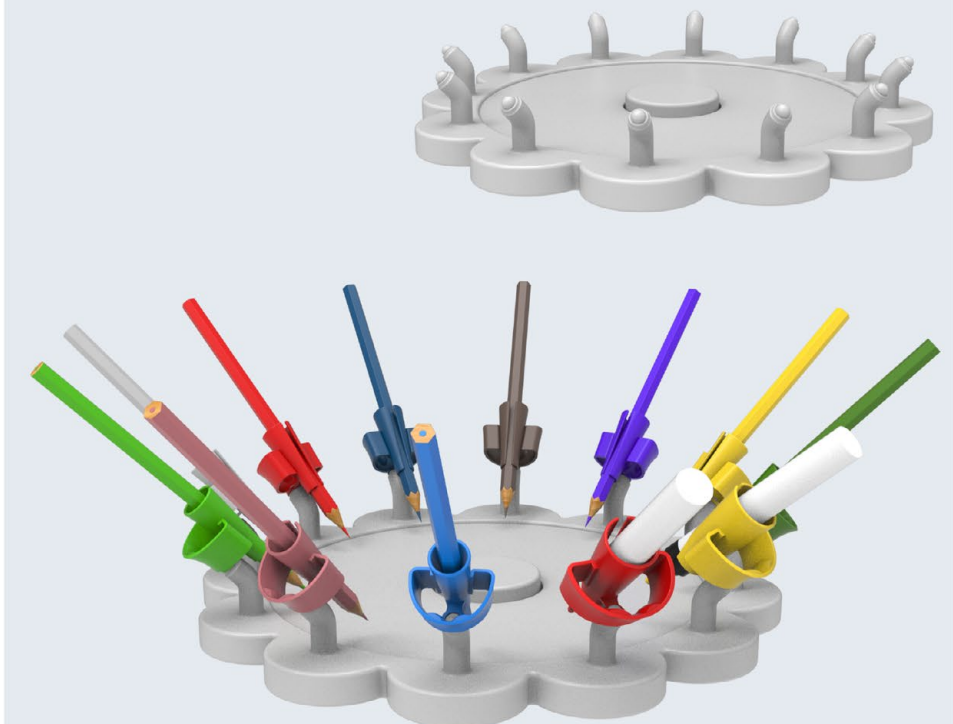
### Size 2

13-14 mm  
Thick Coloring Pencils  
Board Pens  
Markers  
Brushes



### Attachment Stand

Each sizes can attach







Designer / Tasarımcı  
Zeynep Emiroğlu

# TRIHARD

Specialized tripod arm for activities requiring upper body strength and balance.

*Üst vücut gücü ve dengesi gerektiren hareketler için özelleşmiş tripod kol.*

Trihard aims to provide children with limb differences freedom to move. While available models provide pulling movements they cannot aid children with pushing which in some cases result in imbalance in muscles and body. In order to overcome these, Trihard has a tripod hand and an arm support to distribute the weight evenly and a specialized lower arm for strengthening the form.

*Trihard uzuv farklılığı olan çocuklara hareket özgürlüğü sağlamayı amaçlamaktadır. Mevcut modeller çekme hareketlerini sağlayabilirken itme hareketlerini destekleyemiyor ve bu kaslarda ve vücutta dengesizliğe sebep olabiliyor. Bunların üstesinden gelmek için, Trihard'ın ağırlığı eşit olarak dağıtmak için bir tripod eli ve bir kol desteği, formu güçlendirmek için de özelleşmiş bir alt kolu vardır.*



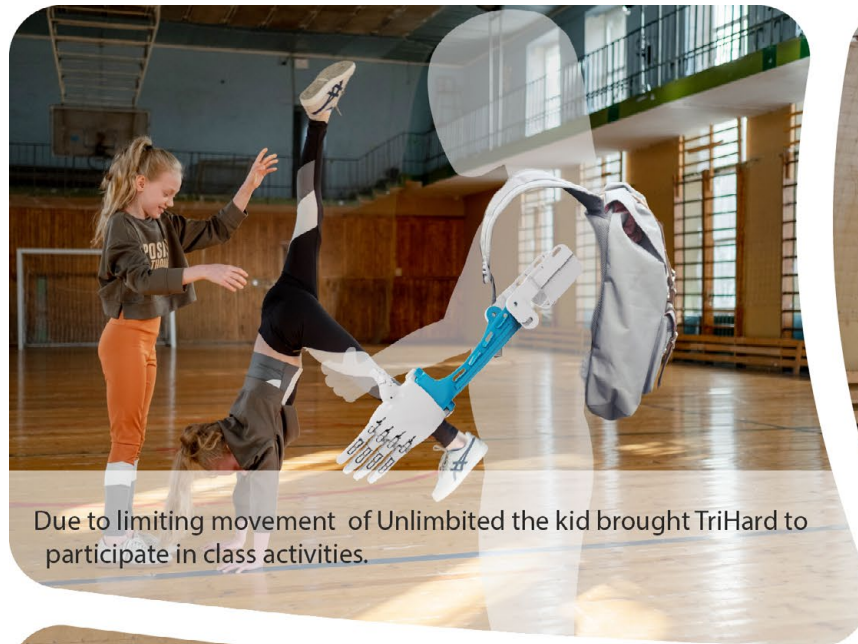


# TriHard

Specialised tripod hand for activities requiring upper body strength and balance.



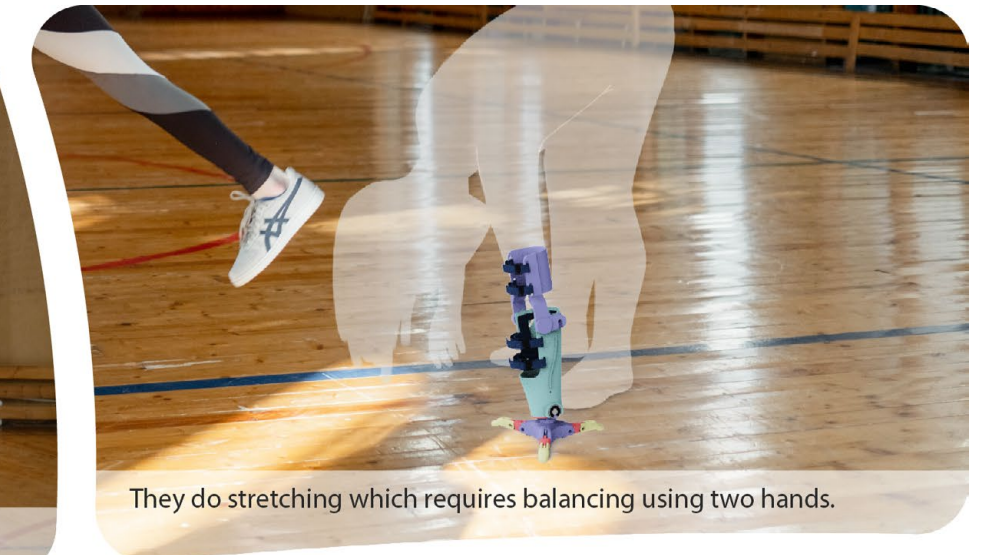
# SCENARIO TRIHARD



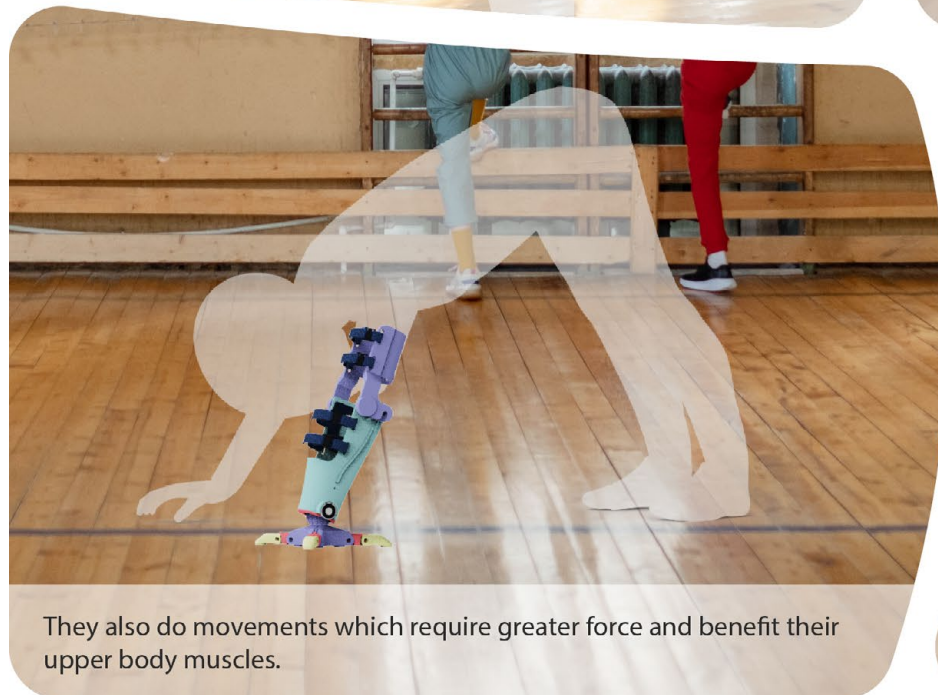
Due to limiting movement of Unlimbited the kid brought TriHard to participate in class activities.



They change their prosthetics which they brought in their backpack before starting to warm up.



They do stretching which requires balancing using two hands.



They also do movements which require greater force and benefit their upper body muscles.



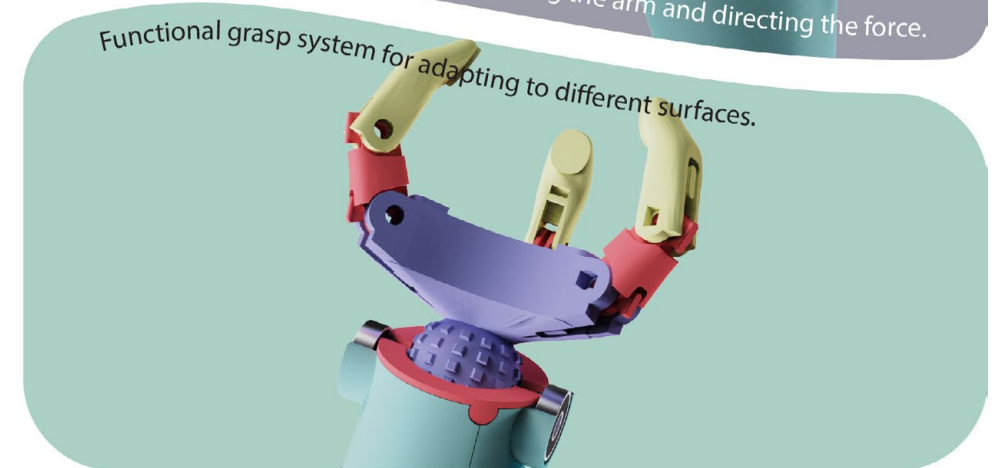
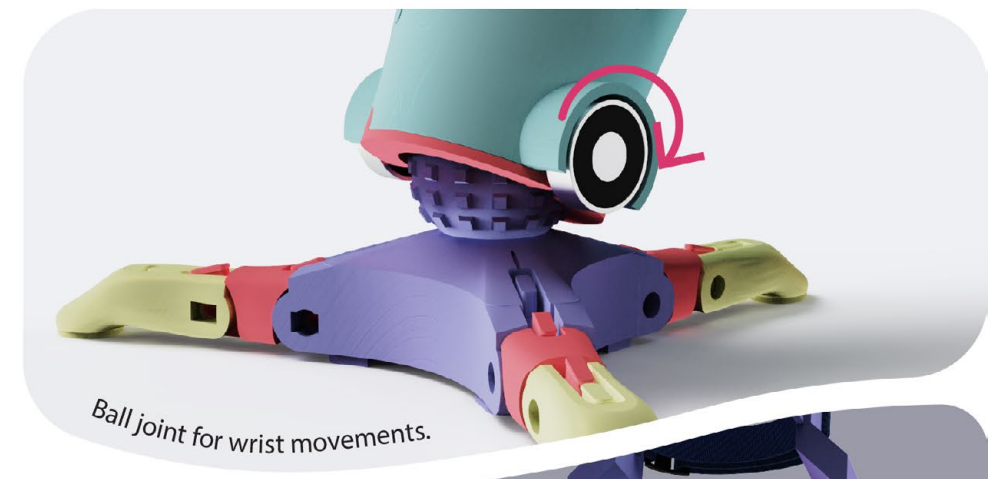
They continue the stretching with more balancing movements.



They even do the exercises that require one hand only.



# DETAILS TRIHARD







**Designer / Tasarımcı**  
Zeynepnaz Acar

# POLESTHETIC

A 3D printed hand design for helping kids with limb differences with skiing comfortably.

*Uzuv farklılıkları olan çocuklara rahatça kayak yapma konusunda yardımcı olmak için 3B baskı el tasarımı.*

**Polesthetic is a 3D printed product that is designed for holding ski pole for the children with limb differences. With the combination of different materials, it offers the most suitable and durable pole grip. Skiing with Polesthetic will be both fun and easy for everyone.**

*Polestetik, uzuv farklılıkları olan çocuklar için kayak sopasını tutmak için tasarlanmış 3D baskı bir protezdir. Farklı malzemelerin kombinasyonu ile en uygun ve dayanıklı baton tutuşunu sunar. Polestetik ile kayak yapmak herkes için hem eğlenceli hem de kolay olacak.*



# POLESTHETIC

Polesthetic is designed for providing the most suitable pole grip.

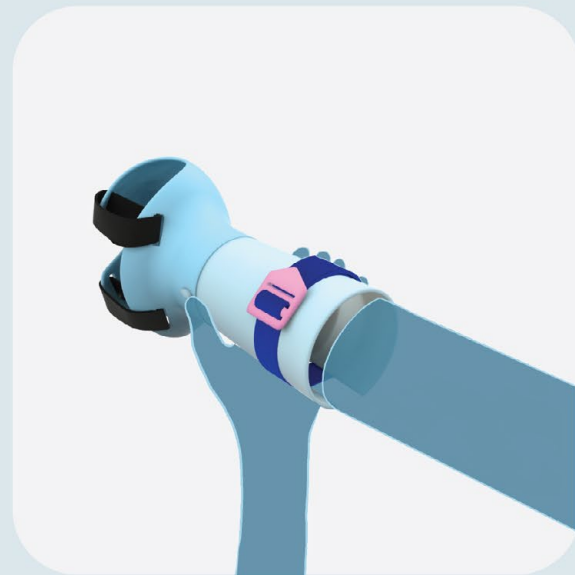




# SCENARIO POLESTHETIC



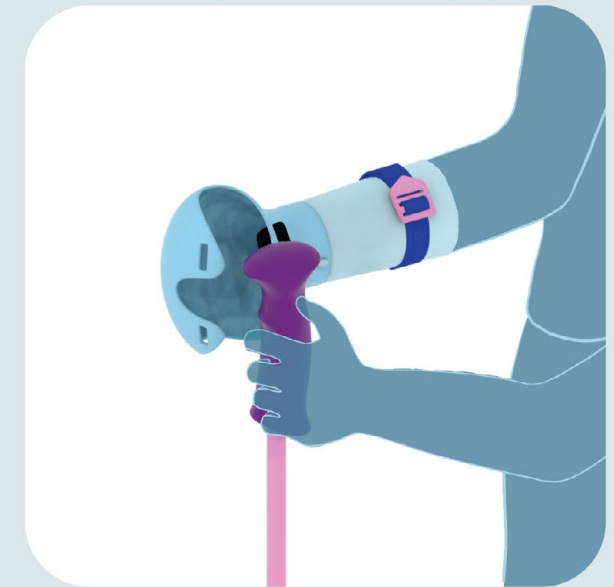
Before use, she removes her usual prosthesis.



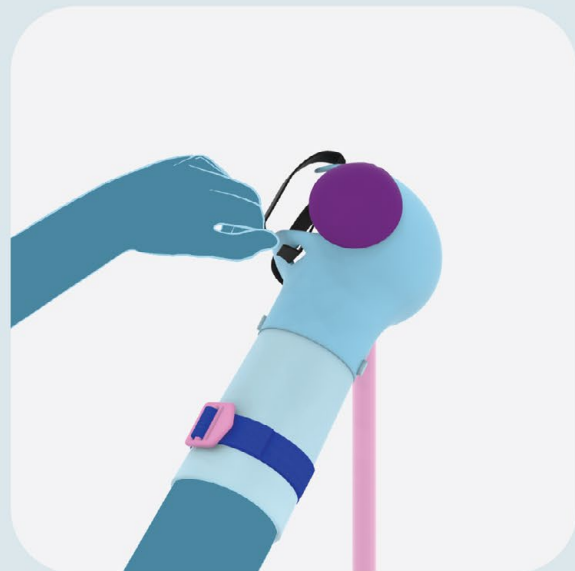
She puts the Polesthetic on in the part that is elastic and adapts to the arm.



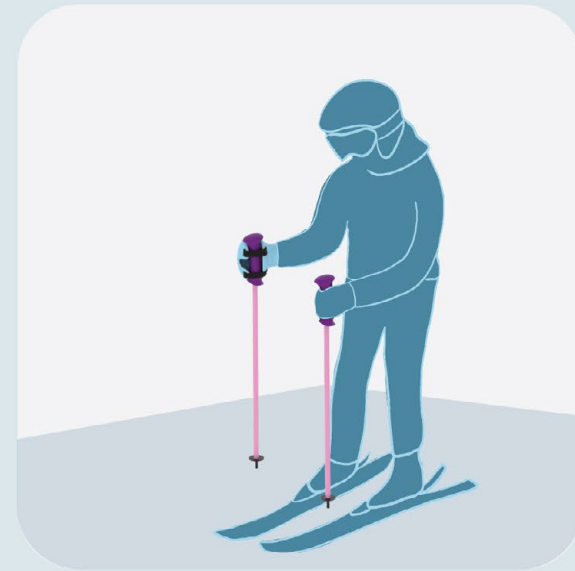
Adjusts the tightness by tightening the belt.



She places the pole in the Polesthetic.



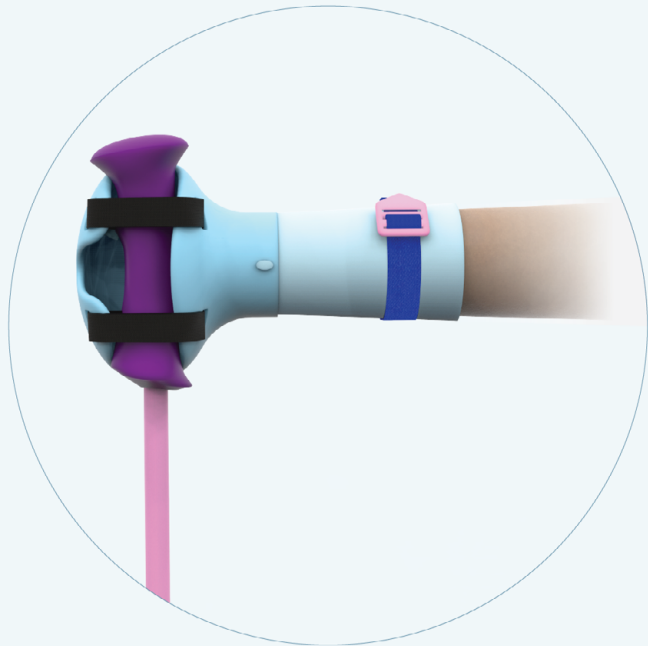
Tightens the velcro.



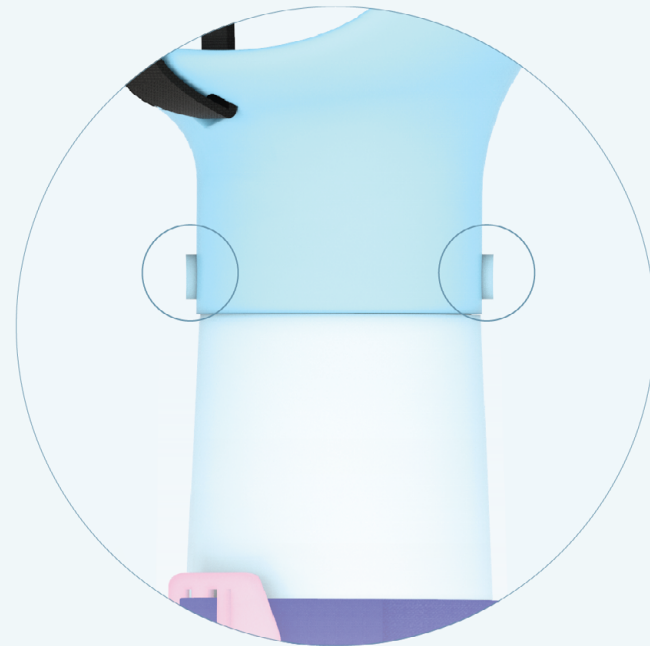
Ready to ski.



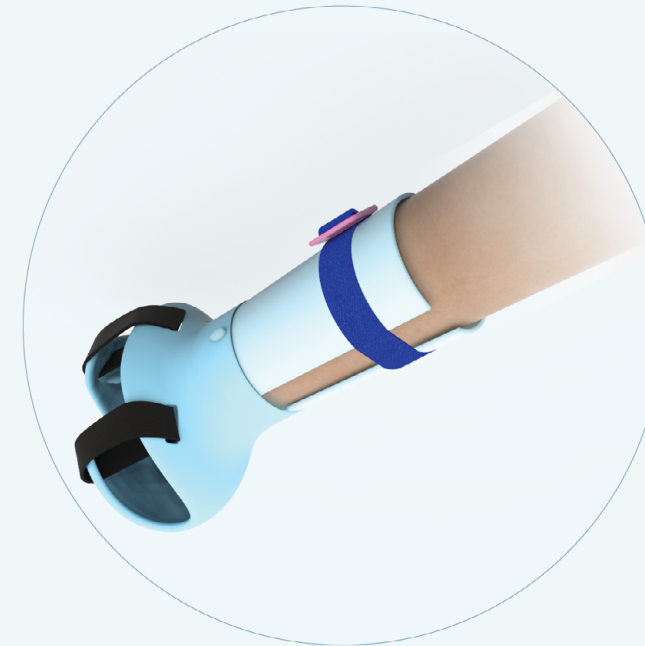
# DETAILS POLESTHETIC



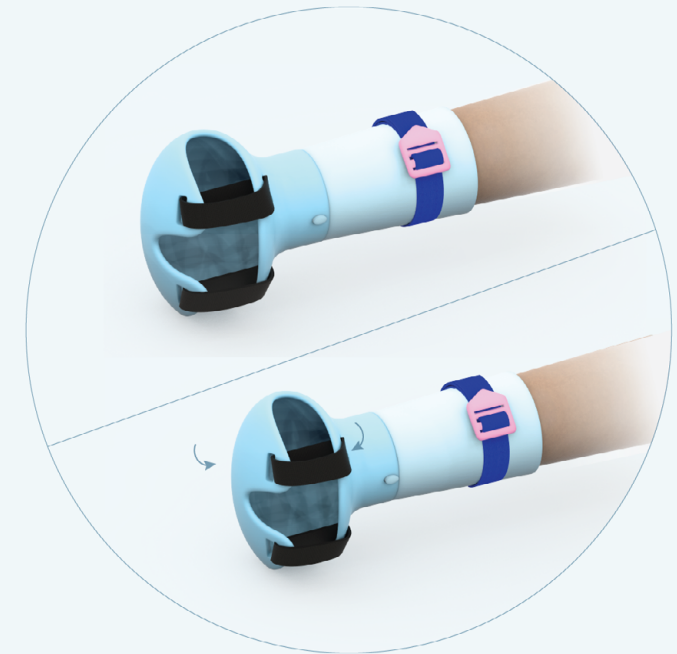
General Usage



Joining Detail



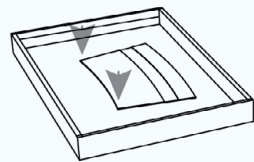
Suitable Form for Arm



Normal / Tight

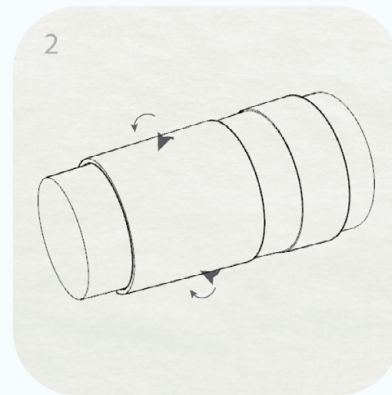
## Assembly

1



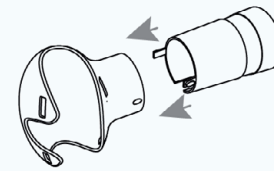
**Thermoforming:** The flat arm piece waits in boiling water for 10-12 seconds to bent.

2



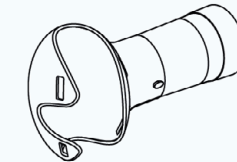
Then bent over a form in a similar form to make the arm shape.

3



The light movable parts on the arm part fit into the slot on the hand part.

4



Polesthetic is ready to be attached with velcro and strap.

### Ready-Made Parts:

- Velcro
- Strap
- Buckle







TED UNIVERSITY INDUSTRIAL  
DESIGN DEPARTMENT

ROBOTEL Türkiye

