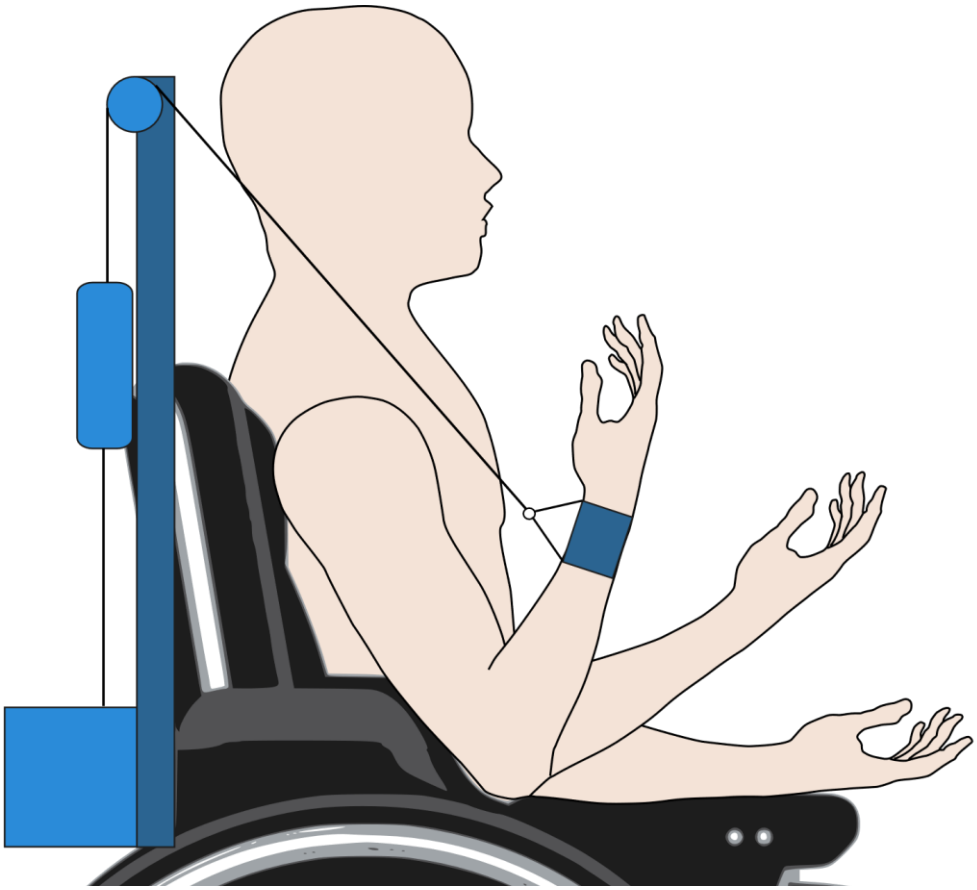
MiAssiSt

- Mike’s Assistive Strength -



User Manual

Preface

Within the scope of my master's thesis, I have met Mike. Mike was born with the neuromuscular disorder spinal muscular atrophy (SMA), which lead to a progressive decrease of his muscle strength over the years of his life. As his condition progressed to a point, where he lost function in all his limbs except the right arm and it became more and more exhausting for him to move said arm, he decided that he would need an assistive system which would support him in everyday activities such as eating, drinking or using computers.

Thus, together, we started developing the MiAssiSt – Mike's Assistive Strength. The MiAssiSt is a do-it-yourself device supporting elbow flexion and extension for users with decreased muscle strength in their upper arm. As passive and active compensation of the weight of the lower arm, the MiAssiSt supports the user in conducting various activities of daily living, giving the user parts of his independence back.

Mike currently uses the first version of his MiAssiSt on a daily basis at home. With his valuable feedback, we try to improve the MiAssiSt for further versions to be able to provide the optimal support not only for Mike but for anyone who might have similar needs as him. Thus, we decided to make our idea accessible and adaptable for everyone.

This manual guides you through the usage of your own MiAssiSt. Please note that the MiAssiSt does not have a certificate. Thus, it is no medical device and usage is on your own risk.

If you have any feedback or possible ideas to further improve the MiAssiSt by yourself, please get in touch with us.

Best regards,

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Content

1. Functionality

The basic principle of the MiAssiSt is shown in the following Figure 1.

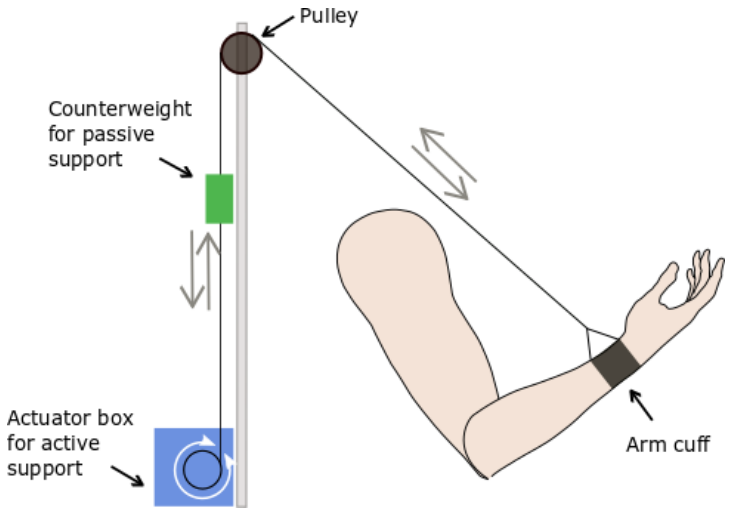

Figure 1: Schematic representation of the MiAssiSt including passive and active support components

1.1 Passive Support

The passive support consists of a counterweight, which steadily compensates a part of the weight of the lower arm. Thus, less muscle strength by the user is required to lift his lower arm. The weight of the counterweight is easily adjustable to the user's individual needs.

1.2 Active Support

The active support consists of a rotating actuator placed in the actuator box connected to a spool. If the command for the active upwards movement is given, the spool will be turned and the rope will be wound up. This pulls the connected counterweight downwards and thus the arm upwards. To move the arm back downwards, the rope will be unwound so that is it is not tensioned anymore and the counterweight may be pulled upwards.

If the MiAssiSt has lifted the arm to the maximum possible height, the movement will be stopped automatically as the counterweight then presses an emergency-stop placed on the top of the actuator box. In this position, only arm downwards movement may be initiated.

2. Safety Information

The MiAssiSt does not have a certificate!
Usage is on your own risk!

2.1 Usage

- The MiAssiSt should only be used as long as an other person remains within calling distance who may interfere in case of an emergency.
- The MiAssiSt is not completely waterproof and should therefore not be used in case of rain.
- Frequent manual checks of the functioning of the emergency-stop are recommended.
- Frequent manual checks of all ropes and knots are recommended. In case of signs of wear or tear, ropes and knots should be replaced.

2.2 Cables and Battery

- Moving, bending and straining of all cables should be avoided where possible.
- The battery is a rechargeable 7.2 V Nickel-metal hybrid battery. The battery should not be exposed to any kind of impacts.
- The battery should be connected as careful as possible. The cables to the connectors should be slightly supported during connection and disconnection.
- If one of the two cables slips out of the connector, it should be carefully put back in. If this is not possible, the active support is no longer useable and the blank metal end of the cable should be covered with insulating tape up until the repair.
- Conductive parts of two inversely polarized wires (e.g. the black and red cables of the battery) may never touch – risk of electrical shorts causing fire!
- If an electrical short of the battery happened, it should immediately be properly recycled and replaced.
- Further specific information concerning the correct and safe handling and charging of the battery are to be found on the user manual of the battery and its charger itself.

3. Setting-Up and Adjustment

The basic principle of the MiAssiSt is shown in the following Figure 2. A more detailed description of the setting-up can be found in the Construction Manual.

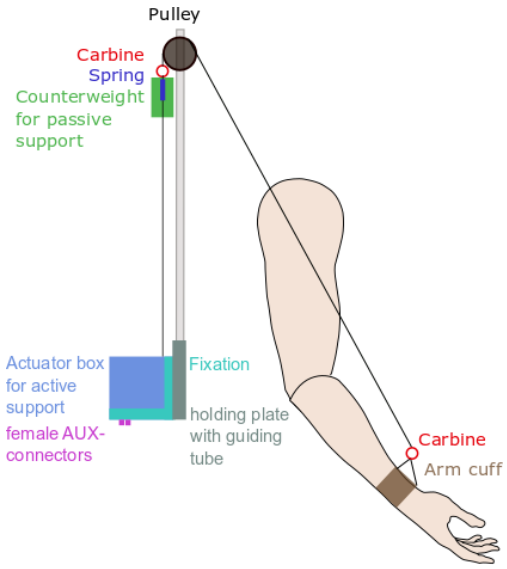

Figure 2: Schematic representation of the set-up of the MiAssiSt. Arm is positioned at the lowest possible position.

3.1 Actuator Box and Pole

The holding plate is fixed to the back of the wheelchair. This is largely dependent on the manufacturing of the wheelchair and should therefore be solved individually.
The actuator box is then mounted to the holding plate with the fixation part. The pole is plugged into the guiding tube of the holding plate and fixed using a cotter.

3.2 Cable

The cable to the battery as well as to the sensor are plugged into the female AUX-connectors on the floor of the actuator box. The cable to the sensor is guided along the arm rest of the unsupported arm and positioned in a way that the commanding finger may be placed comfortably on the sensor. The cable to the battery is guided in a way that the user is able to reach the on/off switch by himself and the battery may be placed easily in a bag or a backpack mounted to the wheelchair.

3.3 Counterweight

The counterweight is filled with lead granule using a funnel until the optimal weight is reached. The weight should be low enough so that the user may lift the counterweight independently during lowering of his arm.

Afterwards, the rope coming from the actuator box including the attached spring are guided through the filled counterweight and its lid and fixed on the lid's top using a carbine. Now the lid can be screwed on the counterweight onto close it.

3.4 Guidance of the Rope and Arm Cuff

To the carbine attached to the counterweight before, another rope should be attached, guided through the pulley and attached to the arm cuff using a second carbine.

The length of the rope between arm cuff and counterweight should be chosen in a way that the counterweight is at its highest possible position when the arm of the user is on its lowest possible position, as shown from carbine to carbine in Figure 2.

4. Starting Up

The arm cuff should be attached comfortably to the front half of the lower arm. The charged battery should be plugged into the battery cable and the power switch switched to “ON”. Now, the status-LED turns on and the MiAssiSt is ready to be used.

5. Controlling

5.1 Controlling of the Passive Support

For controlling the passive support, only the intended movement has to be initiated with the user’s own muscle strength. The counterweight moves along the movement, compensates parts of the weight of the lower arm and thus decreases the strength required by the user to lift his lower arm.

5.2 Controlling of the Active Support

The commanding finger of the unsupported hand should be placed comfortably on the sensor. Depending on the chosen control-program (see construction manual) there are two possibilities to control the MiAssiSt:

A) Double-click program

The MiAssiSt discriminates between three commands: “upwards” and “downwards” and “stop”.

Upwards:	Single-click (up – down – up – stay up)
Downwards:	Double-click (up – down – up – down – up – stay up)
Stop:	Finger resting on sensor (stay down)

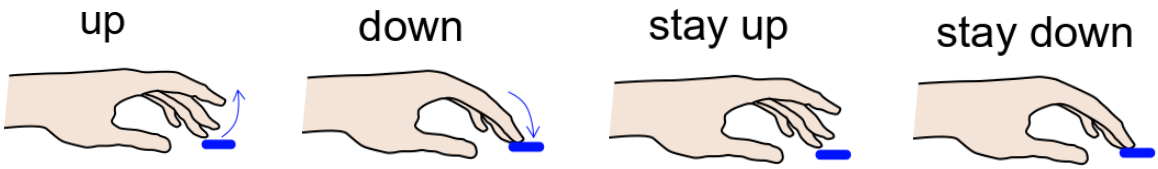

Figure 3: Finger movements for sensor commands

Please note, that in this case a direct change of direction of movement is not possible. To change the direction, the movement has to be stopped first and then again initiated.

The complete unwinding of the rope from the spool in the actuator box, followed by winding up of in the opposite direction should be avoided. If it happens, a repeated unwinding of the rope should be initiated willingly to wind up the rope in the initial direction. If the opposite winding up direction is kept, the commands for the movements are switched and the emergency-stop does not work anymore.

B) Single-click program

In this case, the MiAssiSt discriminates between two commands only: “stop” and “change direction”.

Change direction:	Single-click (up – down – up – stay up) if stopped before or (down – up – stay up) if already in movement.
Stop:	Finger resting on sensor (stay down)

Please note that in this case, after each stop a change of direction is initiated automatically. The movement “upwards – stop – further upwards” is not possible and “upwards – stop – downwards – upwards” has to be initiated instead.

6. Turning off

To turn off the MiAssiSt, the power switch has to be switched to “off”. This completely shuts down the power supply. The battery does not necessarily need to be unplugged.