User and Product Manual Instructions

This document is a template of a user and product manual. The client may wish to make improvements on the prototype or need to fix it if something goes wrong or another group of students may work to make a more rugged prototype. The document needs to be clear for someone else who is not an engineer **to use, maintain or reproduce the project**. Include as many images and diagrams as possible for a better understanding. Keep it plain, simple, visual and logical.

In general, if you are not sure exactly what to include, imagine that this document was the only thing that you had. Imagine also that your job was to add a new feature or recreate the project that is described in your document. What would you need to know?

Only include details relating to your final prototype.

Template conventions:

- Remove all red text, it is only there to guide you
- Remove this page (instructions)
- Replace all instances of <xxx> with the appropriate information for your group, for example you could replace <System Name (Acronym)> by The Amazing Product (TAP)
- Save this document as 'User and Product Manual_group number' instead of Deliverable X so that others know what it represents when they see it in MakeRepo

GNG2101

Design Project User and Product Manual

SKYLIFT: ULNA

USER MANUAL

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Insert your list of figures here (right-click to update this field).

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List of Acronyms and Glossary

Provide a list of acronyms and associated literal translations used within the document. List the acronyms in alphabetical order using a tabular format as depicted below.

Table 1. Acronyms

Acronym	Definition
BOM	Build of Material (list of materials, prices, links)
SUAS	SkyUlna Arm Support (our product)

Provide clear and concise definitions for terms used in this document that may be unfamiliar to readers of the document. Terms are to be listed in alphabetical order.

Table 2. Glossary

Term	Acronym	Definition
Off-the-Shelf		An item you can buy online or in store no fabrication is required.

1 Introduction

This User and Product Manual (UPM) for the SkyUlna Arm Support (SUAS), provides a unique solution crafted to enhance the lives of preteens (10-12) facing limited arm mobility due to conditions such as cerebral palsy and skeletal/muscular deformities. Our commitment to addressing the challenges faced by users like you has led to the development of a product that prioritizes accessibility, affordability, safety, maintainability, and reliability.

This manual aims to provide comprehensive guidance and instructions for various users involved in assembling, installing, and utilizing the SUAS prototype. Our dedication to creating a simple yet visually appealing design aligned with environmental sustainability has resulted in a product that's mountable, lightweight, and easily manageable, ensuring usability for a diverse range of users.

The SUAS stands apart due to its cost-effectiveness achieved through innovative design using off-the-shelf materials. Its adjustable nature allows adaptability to varying user needs and situations, providing a unique solution that not only effectively meets user requirements but also ensures affordability and adjustability tailored for our specific age range of clients.

The manual will walk you through the different components, functionalities, assembly procedures, usage guidelines, and safety precautions associated with the SUAS. Our goal is to seamlessly integrate this solution into your life, ensuring accessibility, affordability, safety, and promoting environmental consciousness.

We invite caregivers, technicians, occupational therapists, and preteens with limited arm mobility to explore this manual and discover how the SUAS can significantly improve daily activities while fostering independence and comfort. Your experience with our product is paramount, and this manual serves as your comprehensive guide to unlock its full potential.

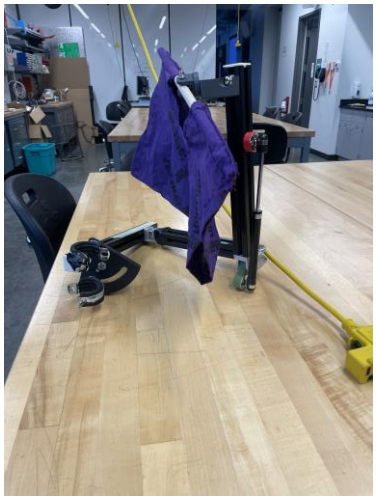
Thank you for choosing SkyUlna Arm Support (SUAS). Let's embark on this journey together towards a more accessible, affordable, and empowered future.

2 Overview

The challenge revolves around helping preteens (10-12) with limited arm mobility with conditions like cerebral palsy and skeletal/muscular deformities. Existing solutions are costly, lack adjustability, and fail to accommodate different age ranges or modularity. Addressing this problem demands a design that prioritizes accessibility, affordability, safety, maintainability, and reliability. By creating an affordable, adaptable, and safe product that supports independence, it can significantly enhance the daily lives of users with limited arm mobility, fostering autonomy and comfort in their day-to-day activities.

Our client seeks a product with a simple yet visually appealing design that aligns with environmental sustainability. It must be mountable, lightweight, and easily manageable to ensure usability. Functionality is crucial, adjustability, repairability, and ergonomic comfort to cater to diverse user needs. Affordability is an important priority. Also, sustainability measures, ensuring a positive environmental impact. Safety for both users and their surroundings is paramount, necessitating a design that upholds safety standards. This comprehensive approach aims to deliver a solution that not only aids limited arm mobility but also integrates seamlessly into users' lives, ensuring accessibility, affordability, and safety while promoting environmental consciousness.

Our product stands apart due to its cost-effectiveness achieved using off-the-shelf materials, which makes it more affordable without hurting the quality to much. Its adjustable nature ensures adaptability to various user needs and situations. By combining cost-efficiency, off-the-shelf materials, adjustability, our product is a unique solution that not only meets user needs effectively but also ensures affordability and adjustability for our age range of clients.



Clamp: Utilizes a pipe clamp with rubber layers for wheelchair attachment. Dual clamps for adjustment on metal framework, providing adaptability for wheelchair tilt.

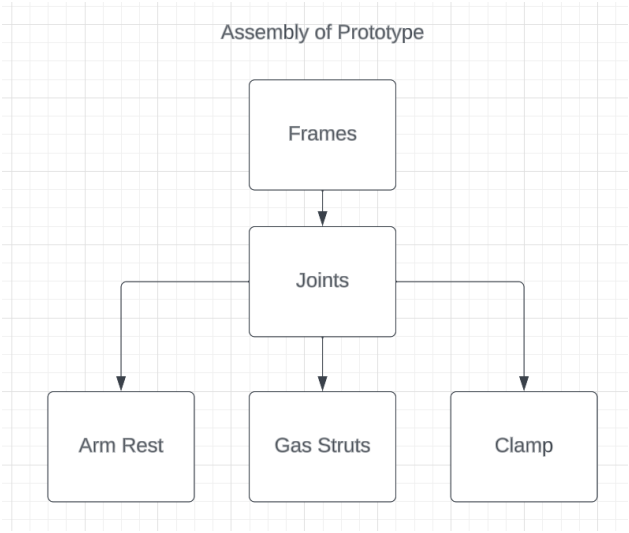
Frame: Anodized aluminum extrusions (Base Arm, Connection Arm, Lift Arm). Customizable operational length with strategically placed holes.

Joints: Off the shelf joints, 180-degree range of rotation, stainless steel, attach to the frame via 8 mm hole.

Gas Strut: Replacement over spring. 100N compression.

Arm Rest: 3D printed Component. Able to do 360 degree rotation. Attaches on via T-Nuts. Arm sling attached to a 12 inch wooden dowel.

The system architecture of our product involves a sturdy metal frame constructed from anodized aluminum extrusions, designed to accommodate. The frame incorporates customizable operational lengths and strategically placed holes, allowing for adaptability and easy adjustments. Our innovative design uses off-the-shelf joints with a wide range of rotation, made from stainless steel and connected to the frame, providing flexibility and durability. The system also incorporates a gas strut, replacing traditional springs, for smooth operation. Additionally, the armrest features a 3D-printed component with a 360-degree rotation capability, attached via T-Nuts, and accompanied by an arm sling fixed to a wooden dowel, prioritizing comfort for the target age range. The user access mode involves a mountable frame, adjustable clamps for wheelchair attachment, for easy customization and control, fulfilling our client's vision for a simple, accessible, and user-friendly solution.



2.1 Conventions

No commands required but just knowing certain terms such as:

Client: Adaptive Toys and Tech Resource Center.

Users: Pre-Teen kids ages 10-12.

2.2 Cautions & Warnings

Before using the prototype, users should be aware of the following cautions and warnings:

1. **Professional Consultation**: Users should consult with a healthcare professional or occupational therapist before using the product to ensure it suits their specific needs and conditions.

2. **Proper Installation**: The assembly and installation process should be conducted carefully, following provided guidelines or by a qualified individual to prevent any potential hazards or misuse.

3. **Weight Capacity**: The prototype has specific weight limitations. Users should adhere to these limitations to avoid overloading the product, which could compromise its structural integrity and safety.

4. **Maintenance and Inspection**: Regular maintenance and periodic inspections are crucial to ensure the product remains in optimal condition. Any signs of wear, damage, or malfunction should be addressed promptly to maintain safety and functionality.

5. **Usage Guidelines**: Users should familiarize themselves with the user manual and guidelines for proper usage, including any limitations or specific operational instructions to prevent accidents or misuse.

3 Getting started

This arm support system incorporates durable components like aluminum extrusions, steel joints, a gas strut, and a versatile armrest assembly, including a wooden dowel and arm sling. Designed for easy wheelchair attachment, adjustability, and user comfort. The comprehensive guide emphasizes safety, clear assembly instructions, and customization options. Featuring a clamping mechanism, adaptable joints, sturdy frame, and adjustable gas strut, this system caters to varying needs while ensuring straightforward operation and secure storage after use.

3.1 Configuration Considerations

List of materials: (all materials link can be found in BOM)

- 30 cm Aluminum Extrusions (x3)
- Stainless steel joints (x3)
- Gas Strut (x1)
- 12 inch Wooden Dowel (x1)
- Arm Sling (x1)
- 3D printed swivel for arm rest (x1)
- Bushing (x1)
- Circular rubber clamps (x2)
- 1 quarter circle clamp
- 3D printed circular joints (x2)
- T-Nuts (x8)
- End Caps (x3)

Starting at the attachment for the wheelchair we have the clamp. The clamp is composed of a quarter circle piece, with a slot to adjust the first rubber clamp. The second rubber clamp is attached to the bottom of the quarter circle. The two rubber clamps will then attach to the wheelchair. Then the whole clamping mechanism will attach to the first frame via joint.

The joints are attached to the aluminum extrusions with T-Nuts that slide into the slot in the extrusion and screw in place, great for adjustability. The frames are aluminum extrusions with slots in the middle of each side, very sturdy material. There are three extrusions in total. Each extrusion is attached to each other with a joint. Each extrusion has an end cap at the end for safety.

The gas strut is attached to the last extrusion. The bottom end is attached to the joint and top end attached to the frame. It is attached with a 3D circular joint the bottom one acting as a stopper for the frame and the top one another circular joint to attach the top end of the strut.

The arm rest is composed of two 3D printed pieces, a wooden dowel, and an arm sling. The 1st 3D printed piece is attached to the last extrusion with two T-Nuts. The second 3D printed piece is attached to the first one with a bushing which allows to swivel movement. The wooden dowel is placed in the middle of the 3D piece and is capable of tilting back and forward. For the arm sling we used a piece of fabric and sewed it to be secure, but it can be any form of arm sling as long as it can attach to the dowel.

3.2 User Access Considerations

The prototype targets preteens (10-12) with limited arm mobility due to cerebral palsy and skeletal/muscular deformities. Children using the system may have different degrees of mobility restrictions. Parents, teachers, and caretakers, who are mainly in charge of installation and supervision, require clear instructions. Accessibility restrictions are primarily linked to users' physical abilities and caregivers' familiarity with assistive devices, emphasizing the need for simple operation and comprehensive user guidance for all involved in the setup and usage.

3.3 Accessing/setting up the System

To attach the arm rest to the wheelchair, you must align the clamps with the frame of the wheelchair. Be cautious, ensure your putting the arm rest on the side that corresponds with the arm needing the arm support (left or right). Tighten the rubber clamps using an Allen key until it is tight to the frame. The arm supports I ready to use, just put the arm needing the arm support in the sling and it’s ready to use. Possible adjustments that can be made are first off with the joints. You can slide them over to make arm support shorter or longer if needed, just need to be cautious with the frame extending out. The strut can be adjusted since it is off the shelf materials you can buy whichever strut force works for your needs, i.e., 45N, 110N. Also, our design is made for a tilting wheelchair. The clamping mechanism can be adjusted with the tilt so the arm support doesn’t tilt with it.

3.4 System Organization & Navigation

3.4.1 Clamping Mechanism

Composed of the two-rubber circular clamp and the quarter circle. Adjustable for the tilt of the wheelchair. This is the part that attaches to the cane of the wheelchair.

3.4.2 Joints

This part of the arm support connects all the other parts together. The clamp to the frame, extrusions to other extrusions and frame to arm rest. The joints attach onto other parts with 8mm screws. When attaching it to the frame it attaches on with T-Nuts. It is the connector of all other parts.

3.4.3 Frame

The frame is composed of three 30 cm aluminum extrusions connected by the joints. It acts as a skeleton of the system being the main support of all the other systems.

3.4.4 Gas Strut

The gas strut is our replacement for our original concept of the spring. It's an off-the shelf product therefore you may purchase which ever gas strut works for your needs. It starts extended but when a certain force is applied it compresses and extends again when that force is taken away.

3.4.5 Arm Rest

The arm rest is composed of multiple components. To begin the 3D printed pieces. The first one is an attachment to the frame it is square shape with a triangle cut out at the bottom to fit around to sides of the frame. It the attaches with T-Nuts. The second piece is a swivel that connects to the first piece with a bushing that allows it to swivel. There is a wooden dowel that is screwed into the center of the piece and allows for a tilting motion. The arm sling itself is just fabric sewed to fit the mechanism, but any sort of sling can be used as long as it fits the dowel.

3.5 Exiting the System

To properly put away the arm support, you must take an Allen key and unscrew the clamps from the cane. Caution: someone should be holding the frame of the support while unscrewing, the arm support is heavy and may fall if no one is holding it. You can then fold the arm support gently and store it.

4 Using the System

Provide a detailed description of each user function and/or feature, explaining in detail the characteristics of the required input (push a lever, button press, etc.) and system-produced output. Each function/feature should be described under a separate sub-section header, 4.1-4.x, and should correspond sequentially to the system functions (e.g., order of actions or menu items) and/or features listed in certain sub-sections found in this document. Include pictures or screenshots as needed to depict examples. This section of the manual may also be tailored or customized based on defined user roles, if appropriate. The information is this section is specific to the user interactions with the system and is different than the prototype documentation section below.

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the <System Name and/or Acronym>.

4.1 <Given Function/Feature>

Describe the specific system function or feature in detail and depict graphically by including pictures or screenshots and descriptive narrative as appropriate. Ensure each figure is captioned and has an associated tag providing appropriate alternative text. Provide information on functionalities that the user must master, expected behaviors, and any special instructions. Identify any caveats and exceptions that the user may encounter specific to the system function.

4.1.1 <Given Sub-Function/Sub-Feature>

Include additional sub-sections as necessary for system sub-functions or sub-features, if they exist.

5 Troubleshooting & Support

Describe all recovery and error correction procedures, including error conditions that may be generated and corrective actions that may need to be taken. Organize the information in sub-sections as appropriate. The following are common sub-sections that may be included as appropriate. Remember that someone who is not an engineer must be able to follow these steps.

5.1 Error Messages or Behaviors

Identify the error messages or behaviors that a user may receive or parts that are prone to breaking and the likely cause(s) and/or possible corrective actions for the error. If the list is extensive, this information may be best provided in an appendix to the document that is referenced here.

5.2 Special Considerations

If applicable, describe any special circumstances, actions, caveats, exceptions, etc., that should be considered for troubleshooting.

5.3 Maintenance

Describe regular maintenance that should be performed on the prototype to avoid failure.

5.4 Support

Provide information on how the user can get emergency assistance and system support (e.g., help desk support, production support, etc.). Include the name(s) of the people responsible and email addresses who serve as points of contact for system support. Also provide instructions for how identified problems with the system are to be reported. Include instructions for security incident handling, as appropriate.

6 Product Documentation

Explain in detail how the final prototype was built including design considerations and calculations. Separate it into categories that make sense for your prototype (mechanical, electrical, software, etc.) and explain the importance of each. If there are options for material/items that you considered or analyzed, explain which ones might be feasible and which ones that your analysis shows are not feasible (with some results to back up your statements, as required). This section should be tailored to your particular prototype.

For example, if stainless steel was an arbitrary choice for a particular part, you could indicate that other materials (e.g. plastic or wood) might also be an option but were not tested. However, if metal that resists corrosion is the basic requirement and you tested several materials before choosing stainless steel (i.e., the choice is not arbitrary) then you can indicate this here, along with supporting data. Sometimes, material needs to be swapped, if no longer obtainable or if no longer cost-effective, present any work that you did that might help another designer make material substitutions or even note the basic requirements (e.g., must resist corrosion in a humid room environment for 30 years).

The same is true for critical portions of software or expensive/sensitive electronic functionality. Basically, if you were worried about a portion of the design and "settled" on a particular solution or method, then it needs to be documented. This includes the testing or analysis that you did to arrive at that specific solution.

Support this explanation with relevant design files you have made (circuit diagram or mechanical diagrams, code, flowchart, 3D models, laser cutting files, etc.). Add pictures to help your explanation. This section should be presented like an instructables manual with many pictures and clear steps to create the prototype.

6.1 <Subsystem 1 of prototype>

6.1.1 BOM (Bill of Materials)

List all the parts/materials/libraries/platforms in this subsystem (include links and price for each item).

6.1.2 Equipment list

List all the equipment that was needed to build this subsystem. This is different then the materials or software listed in the BOM.

6.1.3 Instructions

Explain step by step instructions on how to build this specific subsystem. Include as many pictures as possible and diagrams for clear understanding of the process. Make sure to attach all files you are referencing.

6.2 Testing & Validation

Explain the tests that were done on the prototype for validation of the final design. Present all of the applicable results that you obtained (i.e. data collected, performance graphs, etc.). List any issues or special requirements for sustained usage. Add pictures to help your explanation.

7 Conclusions and Recommendations for Future Work

Summarize your lessons learned and your work related to your prototype and suggest the most productive avenues for future work so that other groups can continue and improve upon your work.

What would you do if you had a few more months to work on this project? What are the things that your abandoned because of lack of time but would be important to add?

8 Bibliography

Insert your list of references here.

APPENDICES

9 APPENDIX I: Design Files

Summarize the relationship of this document to other relevant documents. Provide identifying information for all documents used to arrive at and/or referenced within this document (e.g., related and/or companion documents, prerequisite documents, relevant technical documentation, etc.).

Include all design files in MakerRepo.

Also provide the MakerRepo link to your project.

1. Clamp Front.SLDPRT and Clamp Back.SLDPRT are the two SolidWorks files used in creating the mounting bracket for the two clamps and the arm itself. The engineering drawings for each part are also included in the Maker Repo as .pdf files.

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
clamp front.SLDPRT	https://makerepo.com/rails/active_storage/blobs/redirect/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBdEpXIiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--ecde16072f7bdcefed3a1c63e24b5a70e6246156/clamp%20front.SLDPRT	2023-12-05
clamp back.SLDPRT	https://makerepo.com/rails/active_storage/blobs/redirect/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBdE5XIiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--fb1b9d9356699ef329b210fe18a2c449dae3a2e7/clamp%20back.SLDPRT	2023-12-05

10 APPENDIX II: Other Appendices

You can include other critical and important work here. Maybe they are not important in the structure of this document but need to be included.