

Mobile/Dynamic arm support for wheelchair tennis/adaptive sports/gaming

Preliminary Product Design Specifications

Client: Mr. Dan Dorszynski

Advisor: Professor Willis Tompkins

Team: Roberto Romero, rromero4@wisc.edu - *Team Leader*

Yash Gokhale, ygokhale@wisc.edu - *Communicator*

Mengizem Tizale, tizale@wisc.edu - *BSAC*

Callie Mataczynski, cmataczynski@wisc.edu - *BWIG*

Carlos Veguilla, cveguilla@wisc.edu - *BPAG*

Date: Monday September 25th, 2017

Function:

The function of our product will be to provide mobile arm support for people who have difficulty picking up their arms. This product will be ideal for people who suffer from muscular dystrophy, since it will allow them to perform everyday task such as give handshakes and hugs. Our client specifically wants to use this device to compete in quadriplegic tennis tournaments in order to better perform a forehand and backhand swing.

Client requirements:

- The client does not want us to limit ourselves in terms of designs and said that everything will be fair game.
- The final design would ideally be covered by a shirt, in order to improve the aesthetics.
- The client suggested using bands since he has used bands before to help him move his arms, although he said they are not required.
- The client moves around in an electric powered wheelchair so we have access to a 24 volt battery to power electrical components if need be.
- The focus of this design will be to allow the client to perform a forehand and backhand in tennis by supporting his arm and providing a full range of motion.

Physical and Operational Characteristics:

a. Performance requirements: The product must provide enough support to the arm so the client can easily pick up his arms without becoming fatigued by the end of the game.

The design should also allow him to swing his arms in a full range of motion. Our client should be able to put on and take off the final product by himself.

b. Safety: The product must be free from any sharp or jagged edges and rough surfaces that may cause cuts and abrasions. The product must also not lock in any positions or cause hyperextension.

c. Accuracy and Reliability: The product must conform to the motions of the client. The product must not over or under exaggerate the client's intended motion. The product should do this at all ranges of motion consistently.

d. Life in Service: The product must be able to be used for at least 5 years with the frequency that the client specified.

e. Shelf Life: The product must be able to be stored for 6 to 12 months without use in the case that the client is unable to compete in any tournaments for that time.

f. Operating Environment: The product's operating environment is a tennis court. In this environment the product could be exposed to high temperatures and humidity.

G. Ergonomics: The client is able to push down but is not able to raise the arm. The product must support the client's arm in raising the arm and swinging. The client prefers to have something that is simple and self-installable.

H. Size: The client prefers to have a device that is not too big.

I. Weight: The product must be light enough for the client to self-install. Our client travels and participates in tournaments so a lightweight device that can be easily handled is ideal.

J. Materials: The product must be made from lightweight and durable materials. This is to ensure the client will be able to benefit from the device for a long time of continual use.

K. Aesthetics, Appearance, and Finish: The product must be able to provide a benefit for the client while still being sleek enough so that motion is not inhibited.

Production Characteristics

a. Quantity: At present, the quantity required is simply one with the possibility to be able to adapt the design to accommodate a larger demand.

b. Target Production Cost: No target production cost was established so instead the target is to be kept as low as possible.

Miscellaneous

a. Standards and Specifications: FDA approval is not needed for this device. Adaptive tennis rules and regulations do not interfere with the design of this device. It is allowed to be electronic, mechanical, and/or mounted to the wheelchair.

b. Customer: At the present moment our only customer is our client. This device is specific to our client, but has potential to adapt to other clients. Customers then would include any adaptive tennis players, specifically with muscular dystrophy.

c. Patient-related concerns: The device must be able to suit a fore and backhand stroke. It must also support the weight of the forearm, hand, and partial upper arm as well as tennis racket. This may include a weight of 6-11 lbs. Range of motion should not be limited by the device.

d. Competition: Currently, no design for adaptive tennis supports are on the market. In 2016/17 a UW Madison BME design team made an adaptive tennis grip. Adaption such as leg and lower body supports are sold and can be considered.