



Reach High - Modular Volleyball Exercise Equipment

Michael Hastings and Hunter Miller

University of New Hampshire, Mechanical Engineering

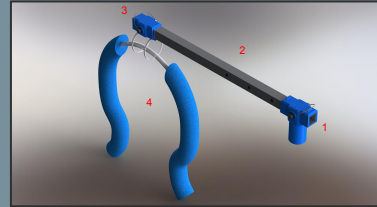
Advised by Ivaylo Nedyalkov and Andrew Wimmer

Special thanks to the Biddeford Men's A Volleyball League for their feedback



Modular Connector

- The modular connector is the central piece of the Reach High system and was initially only designed for use with the hitting attachment (see image right)
- The connector is printed from high strength ABS and features several design improvements for ease of use, durability, and functionality
- The shaft on the bottom of the connector was reinforced with an outer sheath to slip over the extendable pole - this design choice maintains free floating rotation but nearly eliminates the possibility of shear failure
- The channel is equipped to work with any Reach High attachment using 1" square aluminum channel and is held in place by a 5/16" clevis pin that can be seen in any of the solidworks assemblies



Hitting Attachment

- Hitting (see #1 on the far left image) is used to hit or "spike" the ball over the net at a high rate of speed such that the opposing team cannot effectively volley
- A key component of hitting is the player's ability to jump high to clear the net and impart as much energy as possible into the ball
- Additionally, accurate hitting can assure points, while inaccurate hits can serve the opposing team the ball

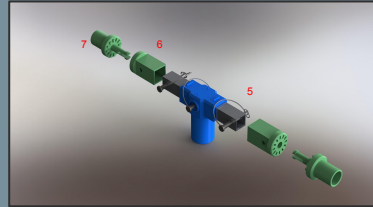


- The goal for the hitting attachment is to train players to jump and hit with Greater power and accuracy
- The assembly is comprised of three main components
- The crossbar is made of 1" square channel aluminum, which was chosen for its high durability and low weight
- The crossbar is affixed to the modular connector with holes spaced at 3" intervals to adjust for players of varying sizes to use the device comfortably - with a maximum length of 32" and a minimum of 23"
- The connector on the end of the crossbar holds the "omega" in place
- The omega is affixed to the end connector loosely to allow the system to compensate for player hits safely and reliably - a rigid system is dangerous for players
- The omega is made of 1/2" diameter PVC that is bent into the shape of an omega and lined by polystyrene padding made from pool noodles
- The flexibility of the PVC omega allows for various ball diameters to be used and the polystyrene padding allows for players to hit the omega without fear of injury



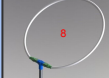
Project Background

- The Reach High system was initially designed and produced by Andrew Wimmer and featured a single attachment system for hitting practice
- The original design featured a hitting attachment with a L-connector and end cap printed from PLA
- The printed parts used press fit connections and an octagonal bore to accommodate a chopped lacrosse stick as a crossbar
- The attachment was held at height by a 3-section extendable pole that could be modified to meet any player's needs
- The extendable pole, omega shape, and omega padding were used in later design iterations for their cost effective and functional design elements

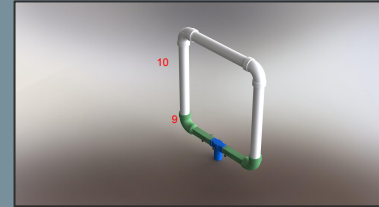


Setting Attachment

- Setting (see #2 on the far right image) is used to set up another player for a spike
- A key component of setting is the player's ability to accurately vector the ball to the location he/she desires
- An accurate set can win a volley by setting another player up properly



- The goal for the setting attachment is to train players to set more accurately for various situations
- The assembly is comprised of a few major components that are affixed to the modular connector
- A shortened aluminum beam joins the connector to the angle adapters on either side
- The angle adapters are printed from high strength ABS and have notches spaced 15 degrees radially to allow the two separate pieces of the angle adapter to lock in at various pitches
- A PVC hoop is locked into the angle adapters and serves as a target for the player to set the ball into
- The variability in the hoop angle allows for players to utilize different setting skills in order to prepare for a variety of volley conditions and player positions



Blocking Attachment

- Blocking is used to prevent the ball from passing onto your side of the court when an opposing player is setting up to hit (see #2 on the far left image)
- A key component of hitting is to avoid an opposing player's block
- Compensating for an opposing player's block can assure a point for your team, while hitting into a blocking player can assure a point for the opposing team



- The goal for the blocking attachment is to use as a training aid during hitting drills while maintaining a lightweight and durable platform
- The assembly is comprised of two corner adapters attached to the modular connector
- The corner adapters are affixed to the modular connector in the same manner that the setting attachment's assembly is, making transitions between attachments easy and fast
- The corner adapters are printed from high strength ABS and take the square profile of the aluminum to a round bend made to fit 2" PVC
- Conventional over the shelf PVC is used to make a rectangular frame 20" tall and 18" wide (roughly the size of a player's forearms and hands when bracing for a block)
- Nylon canvas is held inside the PVC frame to block the ball and rebound it - nylon is chosen for its high strength, adding to the durability of the system

Future Goals

- Testing for a modular system like this must be done on the court using real players, however due to the outbreak of COVID-19, court testing is not possible - plans to work with the women's club volleyball team are a priority with the current designs
- Improving the aesthetics of the system to appeal to the average consumer are tandem to overall functionality
- Creating a portable base for the device makes multi-device usage available to teams and players that do not have others to support the device on its own



Photos courtesy of Jamie Khang