Design and Development of a Robotic Adaptable Belt-Driven Upper Limb Prosthesis Using Stereolithography

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Developing functional prostheses for the upper limb, has historically been a challenge. Amputation of the hand due to military injury, disease, or other trauma carries significant psychosocial implications and healthcare burden, warranting exploration within the field of orthotics & prosthetics. Timely access to prostheses affects device adoption, rehabilitation, cost-effectiveness. This project addresses key issues with current market devices and cable-driven prototype and gear-based prototypes and FDM techniques, focusing on the accessibility and cost-effectiveness of upper-limb prostheses aiming to decrease wait times while ensuring better functionality and reliability over cable-driven and counter-driven designs. Research and development of this device encompasses considerations of anatomy, physiology, prosthetics, biomechanical engineering, robotics, psychosocial factors. Employing computer-aided design and programming logic, the project develops a superior, novel adaptable, reliable belt-driven system, reducing wait times for these devices through iterative, engineering design process, harnessing readily available materials and manufacturing methods. The current iteration features a custom adaptable belt-driven system, allowing the hand to passively adapt objects, completing seven primary grip patterns more effectively. Each finger is individually controlled by a sub-micro servomotor allowing superior control of the device. Sterolithography additive manufacturing techniques are explored to reduce costs, emphasizing readily available off-the-shelf components for efficient replacement part sourcing. Possible applications include usage as a training device, a temporary prosthetic at military/veteran hospitals, and a more accessible, cost-effective permanent device.

Awards Won:

Zydus Pharmaceuticals USA Inc.: Second Place Biomedical Engineering

Arizona State University: Arizona State University ISEF Scholarship (valued at up to $32,000 each)

Westlake University: Westlake University is awarding Pre-college Summer Program Scholarships, covering the program fee, lodging, food, insurance, round-trip international airfare, and excursions in Hangzhou &amp

Shanghai this summer, to up to six finalists.

Society Alumni Special Award: Society for Science Alumni Special Award