Title: Compact-Powered Prosthetic Ankle Device Controlled via Mobile Application

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Keywords: Prosthetic ankle, Compact-powered device, End-user control, Metabolic energy consumption, Robotics, Mobile Application, MIT App Inventor.

Abstract:

The demand for high-quality prosthetic devices remains prevalent in modern healthcare, particularly in restoring mobility for lower-limb amputees and alleviating conditions such as phantom limb syndrome. This research project introduces a pioneering approach centred on the creation of a compact prosthetic ankle device. The primary objectives include restoring user control, minimising metabolic energy consumption, and facilitating intuitive user interaction, drawing inspiration from leading systems employed by industry leaders in the prosthetics market.

The device incorporates a worm gearbox mechanism to reduce its footprint, along with a unidirectional parallel actuation system for enhanced functionality. Notably, the design accommodates the integration of deep learning models for future advancements. Additionally, a mobile application has been developed using the MIT App Inventor platform, ensuring compatibility with a wide range of Bluetooth configurations and commonly used microcontrollers within the research community.

Structurally, the device utilises a combination of aluminium and carbon fibre components, resulting in a total weight of approximately 1.2kg, with ongoing refinement efforts underway. While comprehensive laboratory testing is pending, promising results from initial trials underscore the viability of the device in its current developmental stage.

This initiative represents a significant advancement in the field of prosthetics, offering a compact and technologically sophisticated solution aimed at enhancing the mobility and quality of life for lower limb amputees.

References:

[1] Eslamy, M., Grimmer, M., & Seyfarth, A. (2012, December). Effects of unidirectional parallel springs on required peak power and energy in powered prosthetic ankles: Comparison between different active actuation concepts. In *2012 IEEE International Conference on Robotics and Biomimetics (ROBIO)* (pp. 2406-2412). IEEE.

Title: Advancements in Bio-Inspired Prosthetic Ankle Design

Author: Edwin Espin

Keywords: Prosthetic ankle, Multiple degrees of freedom, Force sensors, Metabolic energy consumption, Unidirectional Spring.

Abstract:

Despite the availability of various prosthetic ankle devices, there remains a pressing need for further advancements in this domain. The sagittal and frontal plane movements of the ankle are pivotal for ensuring user comfort and enhancing the overall experience.

This research introduces a novel bio-inspired prosthetic ankle design aimed at emulating human motion with the utmost precision. Leveraging an innovative approach, the device offers a total of six degrees of freedom, facilitated by a spherical ball joint in conjunction with a unidirectional series linear actuator.

The prosthetic foot, crafted from carbon fibre, incorporates force sensors to enhance adaptability for the end user. Additionally, micro trimmer switches are integrated to reset the position of the linear motor, serving as a safety mechanism to prevent the device from exceeding its range of motion. Powered by a 24V drone battery, the device is fully enclosed, resembling a finalised prototype.

While awaiting final results, two distinct methodologies have been developed to analyse both human and hand-walking cycles, aiding in determining the optimal motion profile for the device.

This innovative prosthetic ankle design represents a significant step forward in prosthetic technology, promising enhanced functionality and an improved user experience for individuals with lower limb amputations.

References:

[1] Au, S. K., Weber, J., & Herr, H. (2009). Powered ankle--foot prosthesis improves walking metabolic economy. *IEEE Transactions on robotics*, *25*(1), 51-66.