Robotic Rehabilitation: Shoulder Motion Sensor

Background
The shoulder joint has long been an enigma to clinicians because of their inability to locate, identify, and treat its minor injuries without surgical exploration. The shoulder has the highest level of mobility of all human joints. It is capable of stably performing its multidirectional movements due to the intricate structure of the attaching muscles. The understanding of the nature of the injuries associated with an action, combined with a measurement of the environment and levels of motions imposed on the joints, allows an understanding of the mechanism(s) causing specific soft tissue structures to be damaged. However, the shoulder’s muscle structure also makes it hard to create an accurate model of the shoulder joint, and it becomes even harder to build an exoskeletal system that captures the shoulder motion. In 2019, a research team at Aalborg University in Denmark proposed a spherical scissor link structure of an exoskeletal shoulder joint [1]. It is small and compact while allowing the wearer to operate within a large portion of the shoulder's original range of motion. This mechanism can be enhanced with sensors to analyze the shoulder movement of an individual with reduced shoulder functionality. This advanced sensor system could gather data that is helpful for the physiotherapist to diagnose the injuries and assess the recovery progress of a given therapy.

Problem and goal
Taking inspiration from the scissor link exoskeleton presented by Castro et al., the task of this project is to:
- Design and build a shoulder exoskeleton mechanism.
- Select and attach sensors to the exoskeleton to measure the different motions of the shoulder.
- Using the sensor readings, estimate the pose of the shoulder and the upper arm relative to the torso.
- Digitally visualize the estimated pose.

Målgrupp: TKAUT, TKDAT, TKTFY, TKELT, TKTEM, TKMAS, TKITE

Gruppstorlek: 3–6 students

Antal grupper: 1

Förkunskapskrav: Designing mechanical systems, designing and building electrical circuits, basics on computer programming.
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