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A NOVEL STRAIN-GAUGE DEVICE FOR MONITORING INTERPHALANX FLEXION/EXTENSION

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Introduction: Monitoring hand joint angles during object manipulation has proved to be a formidable task. However, closed-loop devices for artificial generation of hand mobility require that the latter angles be monitored in real-time fashion. To this end, this work presents a simple, low cost strain-gauge device developed for rehabilitation systems based on neuromuscular electrical stimulation.

Materials and Methods: The device (Figure 1) consists of a 1 mm thick steel sheet attached to an acrylic support. This element is attached proximally to the joint, on the dorsal surface of the finger segment. A strain gauge is attached to the proximal end of the sheet as shown below. A second acrylic element is attached distally to the joint. The latter element has a slot in which the steel sheet slides during the motion. Both acrylic supports are firmly attached to the skin by means of self-adhesive tape. Both halves of the sensor are placed on the finger while the joint is fully extended. This ensures proper attachment of the sheet into the sliding slot. During finger flexion and extension, the sheet bends and returns to its original position. The strain gauge signal is proportional to joint flexion/extension angles. Care must be taken in choosing a metal sheet that will not suffer plastic deformations within the functional range of motion.

Results: The strain gauge signal was found to be linear with respect to joint angles. Further, in tests with human subjects strong linearity was found between strain gauge signals and the diameter of the manipulated object (Figure 2).

Conclusions: The proposed device is low cost and effective. It is also easy to use. Thus, its use should be considered in closed-loop devices for artificial restoration of hand mobility.

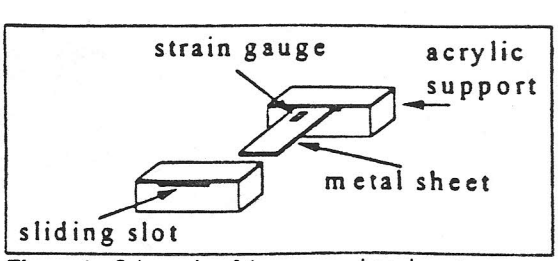

Figure 1 - Schematic of the proposed goniometer

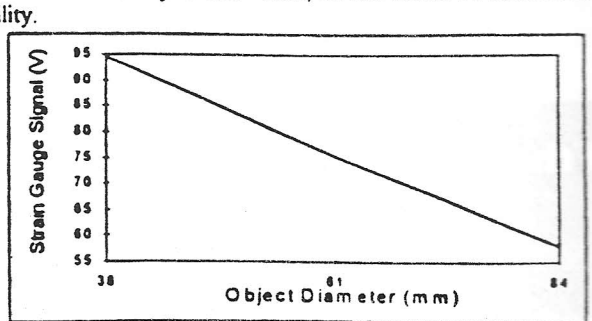

Figure 2 - Sensor response versus object diameter.

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