Teleoperation of a humanoid-robotic hand by a data glove

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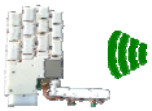
Introduction

Remote control of complex mechatronic systems, in an intuitive way, is not an easy task especially when we refer to robot manipulators and anthropomorphic robotic hands. In this poster we present a mechatronic system for the teleoperetion of a 16 degrees of freedom (d.o.f) robot hand. The system is based on a custom-made data glove that is equipped with 11 flex sensors in order to capture the motion of the thumb and the fingers of the users hand. Moreover, by using a wireless end-point communication the robotic hand can be operated wirelessly. Finally, experimental results are given in order to evaluate the practicability and effectiveness of the application system.

Objectives

• To teleoperate the thumb and the fingers of the robot hand Talos [1] through a motion capture data glove.
•Use Wireless teleoperation.
•Almost real-time operation.
•Use 11 flex sensors in order to capture the motion of the thumb and the fingers.

The 16 DOF robot hand "Talos"

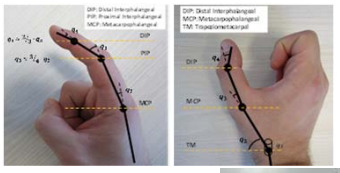


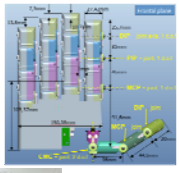
The developed data glove

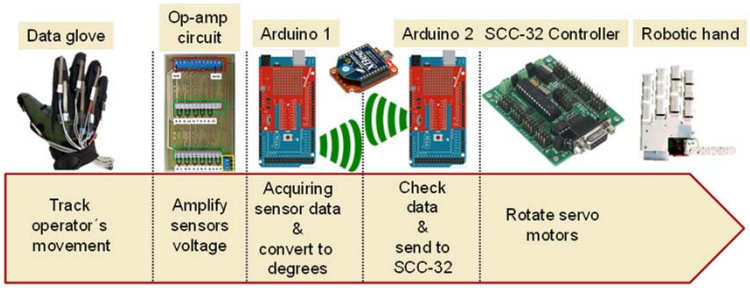
Flex sensors

Methods – System's architecture

- The data glove can track the motion of 11 joints of the human hand and estimate the motion of another 5 joints by using human hand finger constraints described in [2]. The motion of the joints can be captured by using
- Due to the enhanced dexterity of the thumb we use 4 flex sensor to track its motions.







- Each flex-sensor is connected to an non-inverting amplifier in order increase the accuracy of the measurements
- The system consists of two 8-bit microcontrollers (Arduino Mega 2560) with a corresponding a wireless communication module (Xbee shield).
- The RC servo motors of the robot hand are controlled by the SCC-32 servo controller.

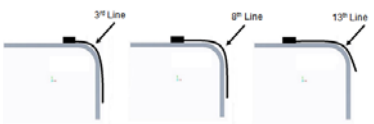
Calibration for the flex-sensors

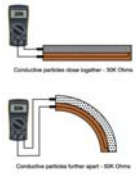
Each sensor is calibrated by conducting experiments to determine the best possible position that the sensor will yield to linear and accurate data.

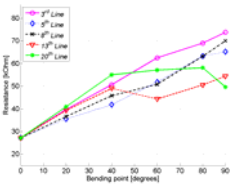
•The sensors were first laid on 3D-printed surfaces with an angle of 20, 40, 60, 80, 90 degs respectively. The radius of curvature for each 3D-printed surface is equal to the human finger radius of curvature (about 15mm).

•A linear relation relates the measured voltage with the flexion of each flex sensor.

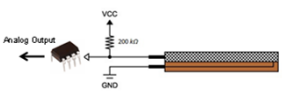
Calibration parts



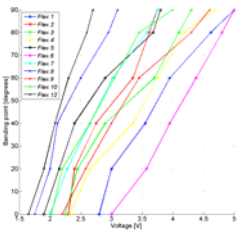




The resistance changes when the sensors are bend



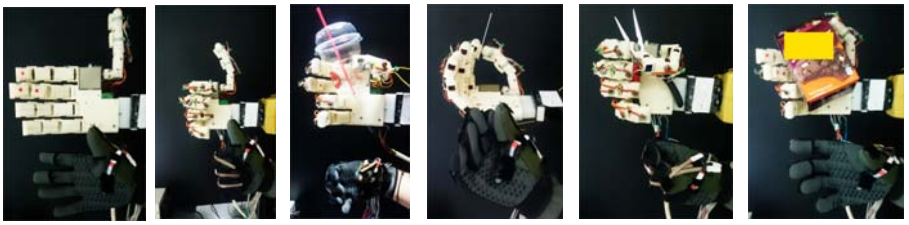
A voltage divider is used for calibrating the sensors



Experiments & Results

Teleoperation of the robotic hand

Below are shown the gestures and grabbing of objects with different geometry that were done by tele-operating the robotic hand by the data glove.



Acknowledgments

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Key References

1. "Design, Development and Control of the Robot Hand TALOS", submitted to AmiEs 2016 as a regular paper by John Fasoulas, Micheal Sfakiotakis, Ioannis Konstantoudakis and Nikolaos Kritsotakis.
2. S. Cobos, M. Fere, M. A. S. Uran & J. Ortego, "Constraints for Realistic Hand Manipulation" Proc. Presence, pp. 369-370, 2007.