FSR Sensor To Improve Sense of Touch

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Sensor technology
Thesis advisor: Prof. Dr. Bertrand Dutoit

The integration of a sensor to control the slipping of an object from the grip of an artificial limb can lead to the person using it being able to perform home/work tasks safely without worrying about the limb failing to perform the task. The integration of these types of sensors into a prosthesis can lead to a marked improvement in a user‘s daily life.

Simone Gagliardi

Introduction

There are many types of prostheses on the international market today: from the most basic ones, which can only perform a few movements, to the more complex ones that can reproduce the almost real movement of a natural limb. One of the most important concepts to be added to these limbs is to be able to give the user feedback on the type of object they are grasping with the prosthesis. The concept of apathetic perception, i.e. the recognition of a given object being grasped, is one of the most sought-after chapters nowadays to be able to give the person who has lost a limb, the possibility of returning to sensations they can no longer experience with their prosthesis. This project is in collaboration with the BFH team for the Cybathlon competition held at the ETH in Zurich.

Goals

The main objective of this thesis is to determine when an object is slipping from the grip of a prosthesis. To do this, a sensor will be developed that can determine whether an object is slipping from the socket. Thanks to the programming of a microcontroller, LEDs will show the movement of an object that is slipping from the hand grip.

Methods

The sensor that has been dimensioned (Figure 1) is a FSR sensor divided into 24 pixels. Each pixel is connected to a voltage divider, which then sends the measured value to the microcontroller (ADC input). Due to the voltage value of the divider, the value measured by the microcontroller will vary according to the pressure applied on the pixel. For the positioning of the microcontroller and the various electronic components, a PCB has been developed. A set of 6 LEDs has been added to visually show the progress of the object‘s drop. When the object is outside the first line or column of the sensor, the first LED will be lit. The same for the subsequent possibilities. The six LEDs are divided into 3 colours (Green, Orange, Red) which indicate the degree of possibility of the object falling to the ground. A ‚Clamp‘ system (Figure 2) has been designed to simulate an index finger and thumb clutching an object.

Results

The response curve to the force applied on the individual pixel yielded the expected results. As hoped, the more force is applied on the pixel, the lower the resistance between the two membranes will be. As the individual pixel value is read directly from the microcontroller, without having to go through an electronic control circuit (multiplexer), the reading response is dependent on the maximum clock frequency of the microcontroller.

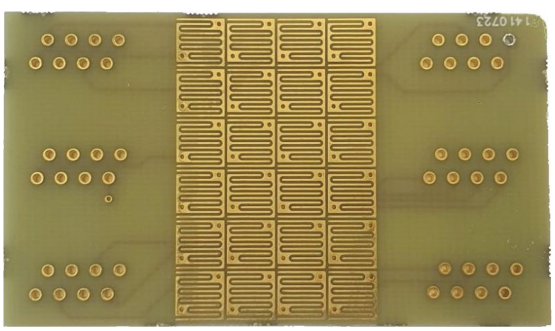

Figure 1: FSR Sensor consisting of 24 individual pixels with a size 5mm x 5mm

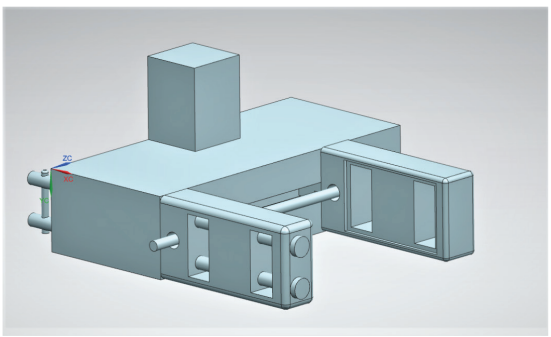

Figure 2: 3D printed clamp©system for grasping objects. In the front, two clamps or fingers can be recognized, where the