EuroEAP Society Challenge 2021

FINAL SUBMISSION FORM

Fill in this form electronically (not manually). Use the following format: Times New Roman, 11pt.

Title of the demo/project:
TouchDetect

Name of the team leader and his/her affiliation:
Ernst-Friedrich Markus Henke, PowerON Ltd./GmbH?, TU Dresden, IHM

Email address of the team leader:
markus@poweron.one

Name of other team members and their affiliation:

Moritz Scharff, PowerON GmbH
Katherine Elizabeth Wilson, PowerON Ltd.
Hui Zhi (Zak) Beh, PowerON Ltd.

Description of the final demo

The widespread integration of robotic assistance systems, be it in industry, household or the service sector fails today, because conventional robotic systems can neither quickly adapt to changing processes, individual and flexible production, nor can they safely collaborate with humans. Safe interaction is difficult to achieve with conventional technology. TouchDetect is an easy-to-use tactile array for robotic finger tips that gives robotic grippers the ability to feel touch, adjust their gripping force accordingly and identify objects, their position and slipping of those. It comes either with USB, industry standard CAN-bus or Bluetooth connectivity and is fully integrated.

Set-up:

TouchDetect arrays possess an array of pressure sensitive sensor points on top of a compliant body. The size of the array and the density of tactile sensor points can be adjusted. Currently the standard array comes with 6x6 tactile pressure sensor points. Figure 1depicts the sensor array. It consists of the compliant 6x6 tactile skin and a compliant body, containing the electronics that provide the measurement data.

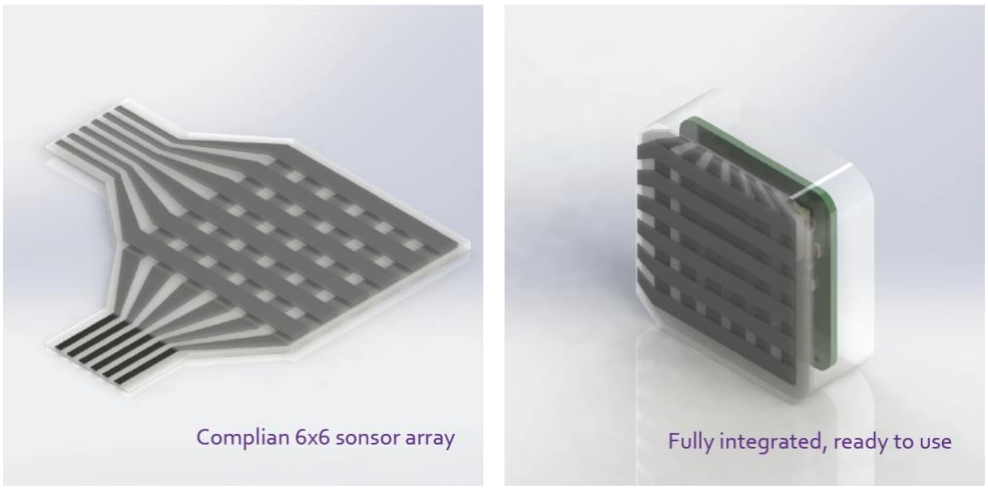

Figure 1 - TouchDetect tactile sensor array.

The sensor array has a squared cross-section of 17 mm edge length and a height of 5 mm. The electrodes of the tactile skin consist of Polydimethylsiloxan (PDMS) and carbon nano tubes. The tactile skin is supported by a silicone body. The silicone body fulfils two functions. On the one hand, it separates the electronics from the tactile skin. On the other, it contributes to the overall flexibility of the sensor. The sensor array is supplied by 5V.
In general, the sensor technology and manufacturing allows for a wide range scaling, both of the sensor array size, as well as number of sensor points and fields of applications.

Connectivity:

When an object touches the sensor surface, the below located sensor points get deformed and changes its electrical resistance, between the corresponding electrodes. Therefore, the resistance change is correlated to the contact pressure. In this relation the object shape is essential. The geometrical dimension regulates the magnitude of contact pressure and simultaneously, the number of activated sensor points. The embedded sensor electronics process the resistance change and provide a signal with a resolution of 4095 digits, encoded in an ISO 11898-1 / CAN 2.0B frame. Consequently, the sensor array can be integrated in any CAN message-based sensor network or used in a standalone application. Finally, the user gets the signal for every sensor point and can combine it with the position of the sensor point inside the array to generate a pressure map of the touching object, see Figure 2.

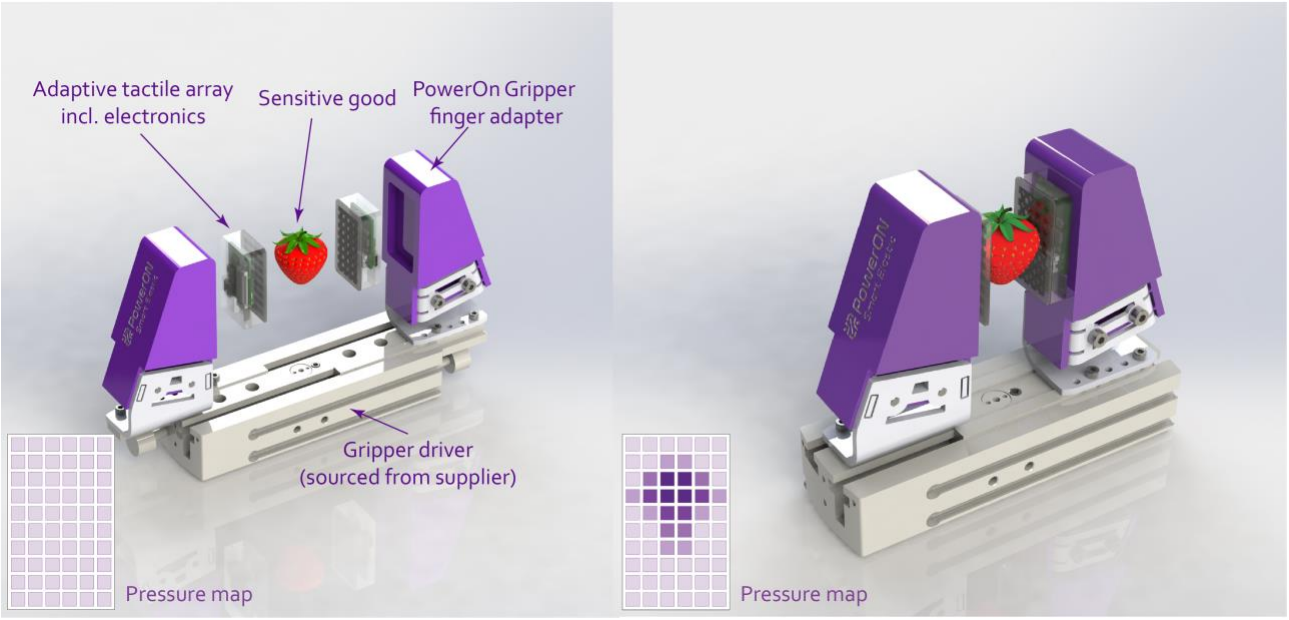

Figure 2 - Application example.

Summary:

TouchDetect is at demonstrator, or MVP stage, respectively. Nevertheless, it was already possible to demonstrate its benefits and to identify some possible improvements that will be introduced to the sensor design within the next months. The recent design of TouchDetect is suitable for, e.g., two-fingered grippers or in more general words, for gripping applications where pressures/forces normal to the sensor surface are generated. Whereas lateral forces cannot be measured directly but related effects can be recognized by processing the measured signals. Since the sensor points are arranged in an array-like structure the shape of an object can be estimated in dependence of the number of sensor points. For a rough identification of an object a small number of sensor point is sufficient but for a close recognition of the object shape a large number of sensor points will be needed or further scanning strategies must be considered. Both would be possible with the technology underlying TouchDetect.
The flexibility of TouchDetect facilitates its use especially in soft robotic systems where classic sensors based on semiconductors, and classic construction materials, such as metals, frequently fail.

TouchDetect is a step forward to soft robot grippers with sensing capacities comparable to the human hand. As nature needed millions of years to design our hands, TouchDetect still will be optimized in a plenty of aspects even if it already works well.

Future work:

In a next step, we will develop a calibration procedure to analyse the relation between deformation and applied load. Here, out of the compliance of the sensor array, arise difficulties since the contact pressure, acting on individual sensor nodes, highly depends on the contact area and shape, which is normally unknown. This effect must be considered in the new procedure in any way, e.g., due to a standardized indenter.

Furthermore, the overall functionality of TouchDetect will be extended to measurements of lateral forces and torques. This will broaden the possible applications beyond basic identification and manipulations tasks.

Link to download a video file of the demo.

https://cloud.poweron.one/s/Nta55PR3qQ5mwji

SIGNATURE OF THE TEAM LEADER

SUBMSSION

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