An Elastomer-based Flexible Optical Force and Tactile Sensor
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INTRODUCTION
The principle goal of the proposed research is to investigate the design and application of an optical-based sensor (See Figure 1). The sensor can sense both force information and tactile information in one elastomer.

SENSOR DESIGN
The proposed sensor consists of
• A flexible elastomer (1) with its fabrication process shown in Figure 3;
• A Flexure structure (2) with cantilever beams (3) that enables the movement of the elastomer.
• A CCD camera (4).
• A LED array (5) to illuminate the elastomer via the light plate (6) for effective image capturing.
• A top cap (7) and a base part (8).

SENSING PRINCIPLE
The raw images are received by the camera, then converted into binary. Once a force is applied, the pins are pushed towards the supporting plate and each pin contact area increases, see Figure 4. We analyse the pixel number of three force-pins areas and one tactile-pins area.

RESULTS
The relationship between the normal force $F_z$ and the number of activated pixels of pin areas $S_i$ is

$$F_z = -0.0081S_1 + 0.1375S_2 + 0.026S_3$$

The proposed sensor using one elastomer can measure real-time normal forces from 0N to 70N (6.6% error), and the pressure distribution can be visualized via grayscale colormap (Figure 6) at the same time.

Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6