Stimulus Distinction in the Skin of a Robot Using Tactile and Shock Sensors

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1. Purpose

The relatively recent appearance of pet robots has resulted in extensive research being conducted on the potential application of mobile and humanoid robots in working environments. Given that robots are likely to cohabitate with humans in a variety of settings in the future, we believe that they will require a skin that can recognize a variety of stimuli. This study therefore aims to develop skin sensors for robots that are capable of recognizing four stimuli that are commonly encountered in daily life. We developed a prototype skin sensor system using shock sensors and pressure sensitive rubber.

2. Elementaly Data at Single Point on Shock Sensor

In developing the skin sensor system, we initially obtained Elementary shock-sensor data at single point. We collected data for four stimulus-types using a fingernail to stimulate the shock sensor directly. Stimulus types were characterized as “Stroked”, “Rubbed”, “Scratched” and “Tickled”. Results of the analyses showed that each stimulus type had a characteristic amplitude and wave form. These findings could be used as elementary data for the detection of four stimuli using this system.

3. Design of Skin Sensor System

In order to realize the above detection system, shock sensors were arranged on the aluminum base board of the skin sensor. Foil tape was positioned between shock sensors, and pressure sensitive silicon rubber was placed on each intersection. Pressure sensitive silicon rubber was used to detect the pressure and position information. Sixty-four shock sensors and intersection of foil tape, which is approximately 10 more sensitive than the human skin.

A photo of the shock-sensor matrix used to detect the differences in acceleration of the four stimuli tested is shown in Fig. 1 and a schematic diagram of the system is shown in Fig. 2.

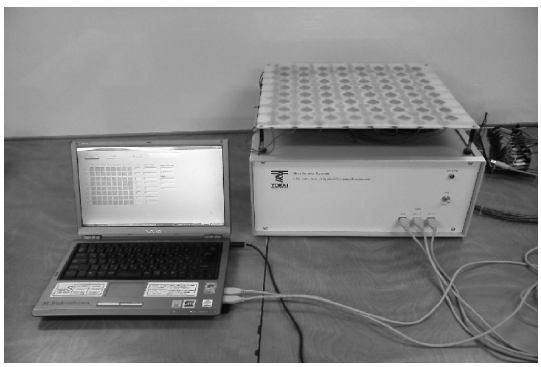


Fig. 1. View of the System

4. The Stimuli Detection by the System

We experimented with pressure and acceleration by using a multi-channel as 7 ch, which are obtained from the developed system. The results demonstrated that the pressure and acceleration of individual stimuli were different. For example, a “Tickle” was measured at approximately 100 g/cm^2, a “Rub” was approximately 600 g/cm^2,a “Scratch” was approximately 85 g/cm^2, and a “Stroke” was approximately 60 g•cm^2. In addition, acceleration and pressure were also observed to differ for each stimulus and the difference in acceleration between “Scratch” and “Rub” was approximately 2G (Fig.3).

5. Conclusion

We found that stimuli provided to the surface of the skin-sensor system in the experiment could be used to distinguish between different kinds of stimuli. Currently, the recognition ratio for the different stimuli is approximately 30-50% when only pressure and acceleration. In order to improve the recognition ratio of the system it is therefore necessary to consider the time series distribution. This research is currently underway in our laboratory.

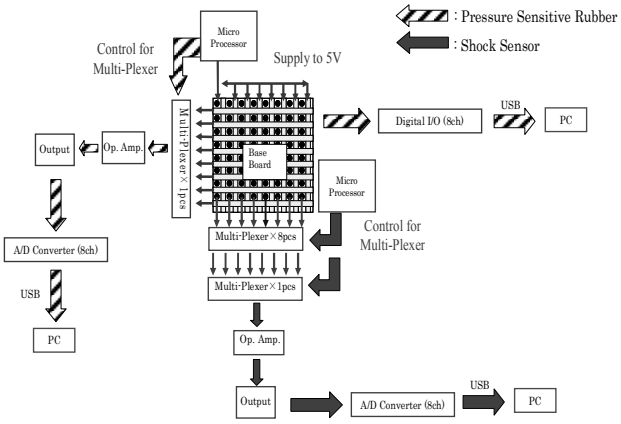
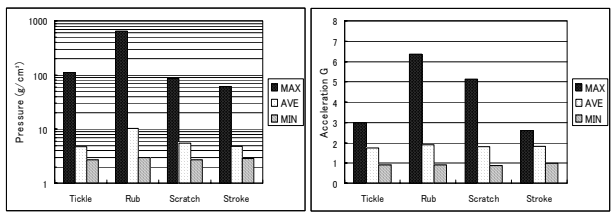


Fig. 2. Structure of the System



(a) Pressure (b) Acceleration

Fig. 3. The Characteristics of the 4 different stimuli