

A stretchable soft-touch musical keyboard

Daniel Xu, Andreas Tairyach, Iain Anderson, The University of Auckland, New Zealand

Background

When Bartolomeo Cristofori (1655-1731) invented a mechanism that struck a series of strings from underneath using hammers wrapped in deer leather, little did he know that this grand invention would go on to create one of the pillars of classical music. His invention *gravicembalo col piano, e forte* which roughly translates to "harpsichord with soft and loud" is attributed as the world's first piano [1].



Cute cat playing piano

Today, not much has changed in the design and way we play this instrument.

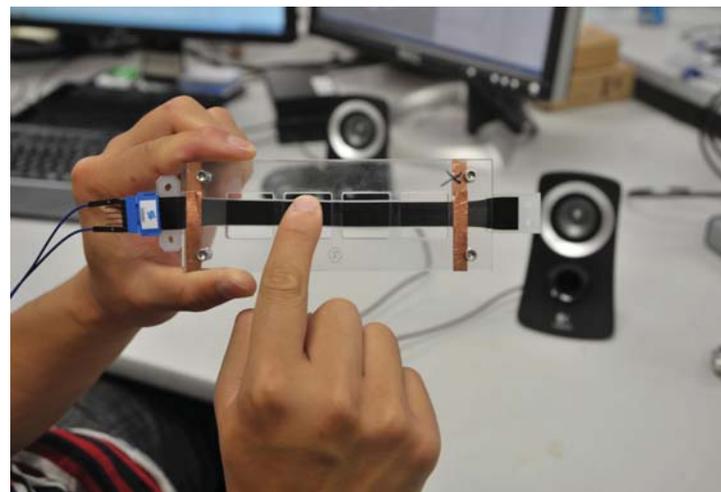
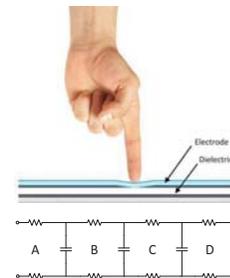
We present a new type of musical keyboard that that is soft, flexible and can be configured into many different shapes and sizes.

Rather than having each key serve as a single note, the keyboard is made from a continuous piece that can create any frequency sounds in between.

Method

The keyboard is constructed from a rubber polymer known as a dielectric elastomer, a sandwich of conductive carbon electrodes and a silicone centre.

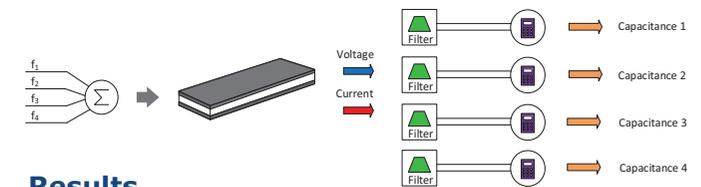
Using a new capacitance sensing method [2], we can determine where we are pressing by measuring the local changes in its capacitance. A speaker is used to play the corresponding frequency notes from measuring the position of contact.



The electrodes of the dielectric elastomer were purposely made to be highly resistive, creating a RC transmission line along the length of the dielectric elastomer.

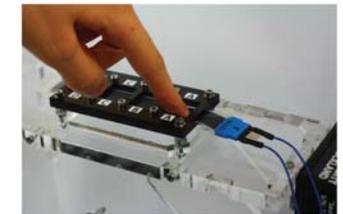
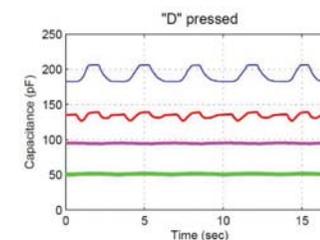
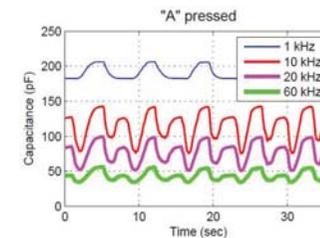
High frequency excitation signals are quickly attenuated as they travel into the material while low frequencies can travel further.

By combining different frequencies targeting a different section of the dielectric elastomer, we can determine where the change in capacitance occurred.



Results

Four distinct regions (A, B, C, D) were marked on the keyboard and its capacitance measured with 4 frequencies simultaneously. A threshold was used to determine the position of contact and the lowest frequency component was used to quantify the amount of pressure.



Conclusion

A soft musical keyboard was made from a single piece of dielectric elastomer. Multiple frequencies was used to locate the contact and pressure.

References

- [1] <http://pianonet.com/all-about-pianos/history-of-the-piano/>
 [2] D, Xu., Anderson, I. "Capacitive Sensor", NZ Patent number NZ627048, (2014)