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Robot Automated Pianos

Piano playing robots have been around for quite a while. However, researchers at the University of Cambridge recently introduced a new version of a robotic piano-playing hand (Yin). This new design is unlike the rest of the previous designs of robotic hands; where the previous robots such as Teotronica use a wide array of motors, this new design incorporates only an arm to move and control the hand that is playing the piano (Mogg). Whereas Teotronica uses its nineteen fingers to play songs quickly and more accurately than any human hand, this robot has the ability to take advantage of the hand’s flexibility ("Listen to this piano-playing robot hit all the right notes."). Additionally, unlike its counterparts, this robot is equipped with a very human-like hand, where it maneuvers similarly to the human hand (Yin). This robot is quite revolutionary in the sense that its design is much more eerily human and takes robot design one step closer to become more lifelike.

This design works similarly to the human hand. From its sheer shape alone, the robotic hand closely resembles the bone structure of the human hands, with the three sections of the hand being quite evident in the robot: the carpus, metacarpus, and phalanges. However, unlike the actual human hand in itself, the robot is only able to move specifically in its carpal, or wrist joint (). This movement is controlled by a single robotic hand that is capable of twisting the robot hand in different motions normally accustomed to the human wrist arm movement. The rest of the robot is kept fairly static, however, its metacarpal joint to its phalanges are actually designed to be able to bend and be less static than the rest of the hands. More towards the computer side, the robot was taught using a machine learning algorithm to move only from the wrist. This allowed the robot to control more so its own choice on how to hit the notes, which finger to use, and when to hit the notes. This helped show the advantage of using a differing mechanical design for its hand.

In a video by Science Daily, they illustrate and highlight the researchers differing robotic hands at different stiffness ratios of the fingers ("Listen to this piano-playing robot hit all the right notes."). The robot was designed by a 3-D printing design that “fabricated the hand with a 3-D printer that blended hard plastic and soft rubber in different ratios to create ligaments and joints with varying degrees of stiffness (Yin)”. These joints were created as such to allow the robot to play the piano quite dynamically and make use of the different piano methods. Currently, the robot is unable to play very demanding piano songs, but it is able to play in the forms of staccato and glissando. Staccato is a method of piano playing in which individuals hit one note at a time (“Staccato”). Additionally, Science Daily highlighted the robot’s ability to slide its fingers up the piano and play each note ("Listen to this piano-playing robot hit all the right notes."). This form of playing is known as glissando ("Music Term: Glissando."). Although the research does not provide with a lot of results, it certainly is one that allows for better understanding of robots and recreating human hand movement. In addition to this, this research has helped people to realize that machine learning can be supported by the design of the mechanical parts of the machine.

Although this research has only the result of a robot being able to play piano as well as any slightly interested person with no piano experience, this research has opened up future possibilities of further enhancements. The research has helped with findings on design with robots that can allow it to do more tasks that the human can with their hands without needing multiple robots to do the same job. This research opens up possibilities of robots one day being able to do tasks that require joint flexibility or a smoother touch by taking advantage of the hand’s natural flexibility to dynamically move in less constrained shapes and methods. Continuing on, robots may be able to have sensors acting in similar ways that human nerves work and allow it to check for tumors or unusual tissue that a normal human may even miss. This research has the possibility of opening up to robotic help becoming more humanoid and lifelike, being able to assist humans in many more endeavors that sometimes humans cannot handle. With this, robots may be able to achieve a more delicate touch when is needed.

Robots have been helping humans do different tasks that require a very rough touch many times or a very specific movement that humans cannot do. However, robots have rarely been able to help with delicate movement and have always been far from being able to do many human functions that human bodies are able to naturally do. For example, gas pedals, humans are able to adjust their footing in different cars to accommodate for speed and movement. However, without natural human flexibility in their joints, robots are unable to do the same movements. They are stuck in the same range of motion that their program tells them to run. With this new design of fingers, robots may be able to adjust to their surroundings one day.

Works Cited

"How do hands work?" Current neurology and neuroscience reports. 26 July 2018. U.S. National Library of Medicine. 03 Feb. 2019 <https://www.ncbi.nlm.nih.gov/books/NBK279362/>.

Magazine, Science. "Listen to this piano-playing robot hit all the right notes." YouTube. 19 Dec. 2018. YouTube. 03 Feb. 2019 <https://www.youtube.com/watch?v=4DX8JQ3U5Ew>.

Mogg, Trevor. "Robotic pianist Teotronica plays faster than a human." Digital Trends. 18 Oct. 2011. Digital Trends. 03 Feb. 2019 <https://www.digitaltrends.com/cool-tech/robotic-pianist-teotronica-plays-faster-than-a-human/>.

"Music Term: Glissando." Cantata - Definition (Artopium's Music Dictionary). 03 Feb. 2019 <https://musicterms.artopium.com/g/Glissando.htm>.

"Staccato." Merriam-Webster. Merriam-Webster. 03 Feb. 2019 <https://www.merriam-webster.com/dictionary/staccato>.

Yin, Steph. "Watch a Robotic Hand Play the Piano With a More Human Touch." The New York Times. 19 Dec. 2018. The New York Times. 03 Feb. 2019 <https://www.nytimes.com/2018/12/19/science/piano-robot-hand.html>.