

HUMAN-MACHINE INTERFACE HARDWARE: THE NEXT DECADE

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In order to understand where human-machine interface hardware is headed, it is important to understand where we are today, how we got there, and what our goals for the future are.

As computers become more capable, faster, and programs become more sophisticated, it becomes apparent that the interface hardware is the key to an exciting future in computing. One only has to look at CAD workstation hardware and the array of tablet, stylus, trackball, knob, and mouse devices which are combined with a maze of menus and function keys to understand the issues. These programs can create visual representations in 2 or 3-D, illustrate attributes of the object, such as stress and temperature distributions, or model and animate the object as it interacts with other objects. How can a user interact and control this seemingly limitless array of parameters effectively? Today, the answer is most often a limitless array of controls. The link between these controls and human sensory motor capabilities does not utilize existing human capabilities to their full extent.

Imagine if the developers of the first car had electronic controls at their disposal and decided to control all car functions through a tablet or an array of switches or dials. They might have argued against a steering wheel as follows, "If a steering wheel is used, both hands are completely occupied at all time. How would you control the speed, or any of the other functions?" The rebuttal might have been, "Use foot pedals which is natural due to experience with walking or cycling." The tablet advocate would have said, "No one will want to use their feet, it's just not natural. Even if people would try it, it wouldn't be smooth and it would damage the whole concept of the car." As you can see, if cars evolved this way, they would be a maze of dials, menus and controls which saturate human sensory capabilities. We'd probably have speed limits of 30 mph due to the limitations in the reaction time as set by the interface hardware. Luckily, the car evolved to take more advantage of human capabilities.

To use the car analogy again, when the car was born, they didn't ask what a car in the year 2000 would look like and leave "hooks" and "scars" for improved technology. If they had, they would have been wrong, as few if any people are able to anticipate technology breakthroughs. They did, however, provide the best that was possible at the time and got the product out to as many people as possible and let time, experience, market demand, and technology innovation lead to the future.

Interface hardware for teleoperation and virtual environments is now facing just such a crossroad in design. Therefore, we as developers need to explore how the combination of interface hardware, human capabilities, and user experience can be blended to get the best performance today and in the future.