In the blink of an electronic eye: A prospectus

ROBERT S. KELLEY and FRANCIS D. TUGGLE
Rice University, Houston, Texas 77001

Some potential uses of computers for education and training paradigms are discussed. These capitalize on the capabilities to provide analog feedback about ongoing "real-time" events. In particular, we examine the use of computers to detect nuances and subtleties in rhythm and timing. Examples are suggested, including new controls for interactive computers and ways of using such machines for training in motor skills.

We (Kelley, Tuggle, Kroskoup, & Person, 1980) have previously suggested using analog controls for computers. Analog feedback methods could apply computer speeds to mental health applications, such as training.

A computer programmed to note what a user is doing on a moment-to-moment basis could adjust its rate of presentation to meet the user's needs. Consider a mechanism for searching a displayed file that slows down and stops at the searched-for item without having to be controlled. The user could also control the system by more conventional means, but the necessity for this would be largely obviated by the computer's ability to recognize the obvious without having to be "told."

There is no question that a mechanism of this kind can be constructed. A machine equipped to measure eye saccades and head position could detect when and approximately where the user was looking on the screen. When the number of saccades directed toward some point in the moving display reached a predetermined frequency, the moving display could be made to slow down, stopping if saccades about the point remained high and leaving the attended item in the middle of the screen. More conventional means, such as an override button, spoken "go on," or other control also triggered by a look, could be available to immediately eliminate any misunderstandings.

Such equipment is currently elaborate, expensive, and cumbersome. A simpler approach might be equally effective. For example, attention is correlated (to a point) with arousal (cf. Navon & Gopher, Note 1), and also with simple physiological measures such as pulse and breathing rates and their derivatives. These might be substitutes for measures of eye saccades.

A third possibility, simpler still, involves attaching an ordinary photocell to a terminal situated in a constant-lighting environment. Body motions of the user would be reflected in changes of voltage produced by the photocell. Attention would be manifested as an identifiable change in motion (and thus voltage change) as the user oriented toward the object of interest. The change might be smooth or abruptly discontinuous, but it would presumably stand out against its temporal back-

ground. Even direction of attention might be manifested as a change in the mean light level detected: If the user is attending to the display, he or she will very likely be leaning forward and blocking the light.

While it remains to develop these proposals in detail and to test them, the point should be emphasized that the system by no means need always make the right guess to be useful. Indeed, it almost certainly cannot be made perfect in this respect. However, even a moderate level of accuracy is likely to lead to a reduction in the number of commands required.

Dramatic uses exist for machines equipped to detect human nuances of timing. A prominent example can be found by extending those efforts made in the area of adaptive training, which involves the use of computer able to modify a training presentation in the process of presenting it, thus tailoring the session to the needs of the individual. Instances of adaptive procedures may be found in Atkinson (1976), Hudson (1969), and Williges and Williges (1978), among others.

For example, consider the problem of teaching driving. One might begin with the simplest tasks, for which unique solutions exist, such as "make a smooth left turn." To guide the subject, equip the car with a computer that is capable of detecting speed and position of the car in three dimensions and is able to issue prompts to the user. After the subject is thoroughly trained in the use of the prompts, driver training may begin. The computer can be programmed to generate inertially optimal corrections for deviations from course. It then takes the subject through the driving process providing the opportunity to discover firsthand what it feels like to be driving well.

Similar paradigms apply to spacecraft pilot training and to wheelchair skills. A large number of such situations may then be presented to the trainee; in fact, an situation for which an optimal solution exists may be included.

It is desirable to be able to extend the approach to situations for which an optimal solution either does not exist or is unknown. This is more complex; in this case the machine must follow a heuristic strategy, prompting only when it is relatively sure it offers good advice.

One approach to acquiring a background of good advice is as follows: Record the responses of skilled individuals in many situations similar to those in which a person is to be trained. During training sessions, the machine would then regress on the recorded performances, attempting to find those that bear the most resemblance to the current situation and the subject's own style and that best satisfy any remaining optimality criteria such as conservation of momentum.

DISCUSSION

Needless to say, what has been described above will undoubtedly prove quite difficult to implement; still, by beginning with the simplest problems and gradually attempting to extend the approach, it is probable that much can be achieved. Eventually, computers equipped as described above will offer trainees, educators, and therapists unprecedented affordance of background control that is personalized to the individual and permits

flexible, changing "envelopes" of guidance created with the speed of light.

REFERENCE NOTE

1. Navon, D., & Gopher, D. *On the economy of the human processing system: A model of multiple capacity* (Tech. Rep. AFOSR-77-1). Haifa, Israel: Technion—Israel Institute of Technology, 1977.

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