A Nose Gesture Interface Device: Extending Virtual Realities *

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Abstract

This paper reports[1] on the development of a nose-machine interface device that provides real-time gesture, position, smell and facial expression information. The DATANOSE^{TM}[2]—**D**ata **A**toma**T**a CORNUCOPI**A** p**N**eumatic **O**lfactory I/O-devi**SE** **T**actile **M**anipulation[Olsen86, Myers91]—allows novice users without any formal nose training to perform complex interactive tasks.

1 Hardware Design

There are many different types of plastic noses commonly sold in novelty stores[Spencer Gifts]. Several different formats were tried: pig nose, elephant nose, rabbit nose, cow nose, mouse nose, duck nose, witch nose and cat nose. (Figure 1 shows six commonly available alternative nose formats.) Each proved to have serious disadvantages. For example, the pig nose was uncomfortable after several hours of use and the whiskers on the mouse [3] and rabbit noses tended to get caught in printers.

Because of its simplicity, sturdy attachment mechanism, and availability, the Groucho Marx nose was chosen as our hardware platform. (Note that not all Groucho noses are the same. Subtle physical variations can cause substantial differences in usability [Buxton86]).

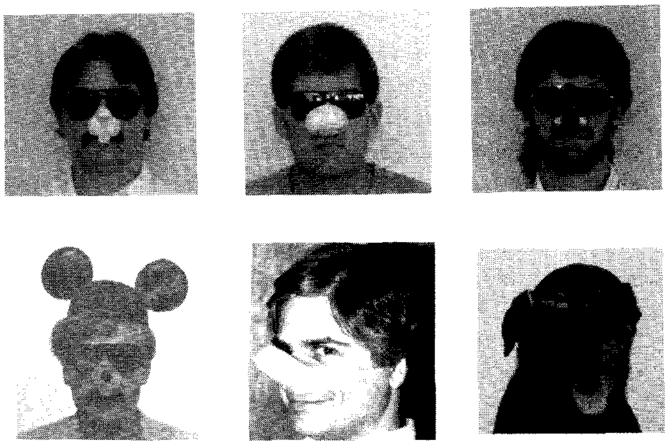

Figure 1: Alternative Noses: Bunny, Pig, Elephant, Mouse, Duck, Dog

The initial DATANOSE^{TM} prototype mounted the nose to a motorcycle helmet[NASA], see Figure 2. After problems with nosebleeds, hay fever and unexplained nausea, we dispensed with the helmet platform and decided to use the traditional sturdy black rimmed glasses that come with the nose.

2 Rhino-Virtual Realities

Early rhino-virtual realities relied on rapid horizontal motion—twitching—as the only interaction method[Bewitched]. The addition of modern hardware and software techniques to nose-based virtual realities allows the DATANOSE^{TM} to use multiple interaction methods. A Polhemus—comfortably situated inside the

*This work was not sponsored at all by the Kimberly-Clarke Corporation, but we are sure they would approve of it.

[1] This document was formatted by TeX.

[2] DATANOSE is not a registered trademark, the ^{TM} is just part of its name.

[3] Problems with the whiskers on the mouse nose directly contradicts previous mouse results which showed that a mouse would be best for all tasks [Card78].

Figure 2: Motorcycle Helmet Platform[4]

nose—allows for nose movement in all 3 dimensions to be measured. Touch sensitive plates embedded in the tip allow for nose-to-screen and nose-to-keyboard interactions. Pneumatic input and output sensors allow for air pressure inside the DATANOSE^{TM} to be used as another interaction mode. Combinations of these interaction methods can be particularly powerful. The section 3 presents an example of how multiple interaction modes can be used to perform one complicated action.

Assigning unique smells to objects provides users with a valuable method for distinguishing amoung interaction objects. Novice users find it particularly helpful when learning how to use a new interface. While they may not remember what action a particular interactor performs simply by looking at it, once they smell it, they often remember its function. Our prototype aromatic interface went one step further by assigning unpleasant odors to actions that an expert system calculated to be nonoptimal.

The addition of multiple degrees of interaction to rhino-virtual realities allows non-expert users to perform tasks that previously could only be accomplished by experts and therefore takes us one step closer to realizing virtual wrestling.

3 Picking and Rotating 3-D Objects

The DATANOSE^{TM} has sufficient versatility to replace many different interaction devices. For example, the dragging and selection operations commonly

[3]Actually the model shown is mounted on a bicycle helmet, since we could not find a motorcycle helmet that fit. The wires sticking into the nose are surprisingly comfortable and do not interfere with sneezing.

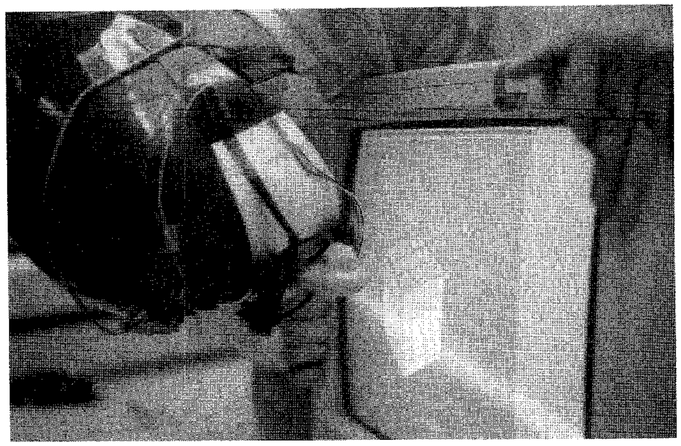

Figure 3: Rotating 3-D Objects

done by mice can be more easily accomplished with the DATANOSE^{TM}. Users can select object simply by pressing the nose against the screen and can move objects simply by dragging the nose across the screen[5].

In addition to simple 2-D selection tasks, the DATANOSE^{TM} is an excellent 3-D selection device. Users can easily select and rotate 3-D objects. Objects are selected by pressing the nose against the screen and hoovering[6] over the object to be rotated. The user can then rotate the object by rotating their head. Figure 3 shows how easy it is to rotate an object about the z-axis. Rotation about other axes is equally effortless as shown in the following complexity result: $\mathsf{N} = O(S^e)$. Note that the DATANOSE^{TM} offers true user-centered rotation in the user's own nasal coordinate system, rather than conventional object-centered rotation. Therefore the DATANOSE^{TM} empowers the user instead of the object[ACM SigCHI90].

4 Human Factors Experiments

We were planning to test our new interface device with the canonical 16 test users, but our funding was limited. In lieu of these extensive tests, we asked one user with no previous nose-computer experience (an undergrad, only cost us $2.50). He/she liked it.

5 User Interface

As shown by previous research and surveys, the user interface takes up between 2% and 98% of the code

[5]Due to the plastic construction, the DATANOSE^{TM} does not smear the screen nearly as much as a human nose.

[6]**Hoovering**, *vt* **1** : the act of producing a vacuum **2** : to use a vacuum device (as a cleaner) upon **3** : *(slang)* the act of interacting with a computer using a nose interaction device.

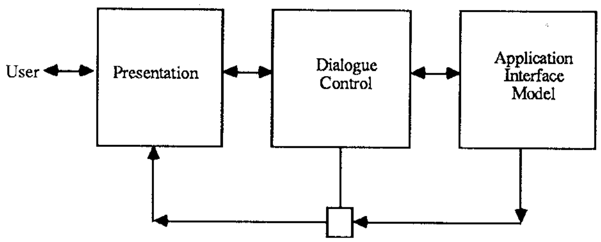

Figure 4: Seeheim User Interface Model

[Sutton78]. In order to avoid the high cost of creating a user interface for the DATANOSE^{TM} the SYSTEM (System that reallY doeS creaTE user interfaces that have nice featuMs) User Interface System has been developed over the course of six years by a team of thirty-two undergraduates. SYSTEM is based on ideas from previous User Interface Management Systems, such as Guide [Kilgour85], Guide [Granor86], Guide [Sun91], Guide [Owl91], Guide [Oren91], Guide [Trident91], and Guide [Kantorowitz89].

SYSTEM allows the user interface designer to create a tremendous variety of wonderful, user-friendly, stupendous, fascinating direct manipulation user interfaces with a minimum of specification. SYSTEM is one of the few systems that, in addition to managing the user's windows, will also actually wash them.

The SYSTEM system is broken down into three subsystems using a systematic decomposition strategy resulting in a systemic user interface which is useful and useable by the user. This is based on the Seiheim model [Green83] shown in Figure 4.

In order to specify the Presentation component, the designer writes a BNF description of the graphical elements in the user interface. The next step is to define the dialogue using a direct manipulation, graphical editor. Here, the designer creates nodes that represent the actions that the user might take, and links them together into a meaningful network, to show what command can follow which other command. As an example of a SYSTEM transition network, Figure 5 shows the network for an emacs like editor.

Next, as with most other systems conforming to the Seeheim model, the designer specifies essentially the entire user interface, by writing code for the little, unlabeled box at the bottom of Figure 4. This code will cause the display objects to appear at the correct places, and implement the commands described in the dialogue section. Finally, the designer can write the application in whatever language is desired.

The AI component automatically determines whether any of the specified interactions will cause the user's nose to get out of joint. It uses a conventional rule-

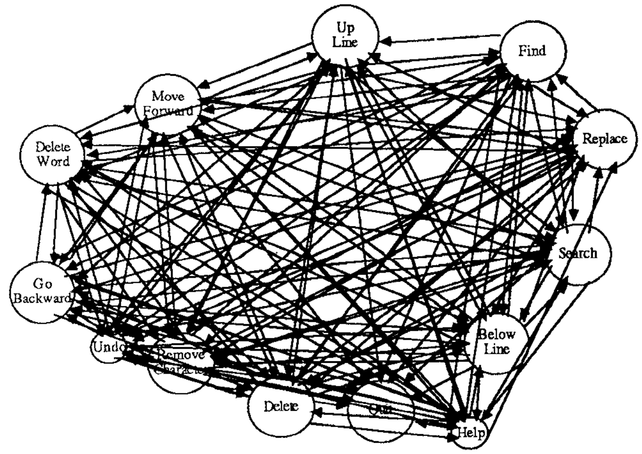

Figure 5: Example Transition Network

based back-propagation hidden-Markov model Boltzmann neural network perceptron with a gradient-descent sigmoid non-linear error function based on a frame-based semantic network knowledge representation system performing massively-parallel simulation of thought processes.

6 Future Work

Initial research has shown several other body parts and articles of clothing to be prime candidates for I/O devices: DataArm^{TM}, DataFoot^{TM}, DataHead^{TM}, DataSocks^{TM}, DataMouth^{TM}, DataEyeballs^{TM}, DataEars^{TM}, DataUnderwear^{TM}, DataShoe^{TM} (not to be confused with the ShoePhone[Smart#86]). In addition to exploring new types of clothing, combinations of *Data**^{TM} I/O devices can provide never before thought of possibilities. For example, the combination of the DataGlove^{TM} [7] and the DATANOSE^{TM} allows for a greater range of picking tasks than a simple mouse[8]. As another example, the combination of the DataSuit^{TM}[6] and DataUnderwear^{TM} allows the user to simultaneously interact on multiple levels.

In addition to developing new *Data**^{TM} I/O devices and experimenting with combinations, more economical versions such as the PowerNose^{TM} are being developed. (The PowerNose^{TM} will be compatible with most home video games and will prove indispensable to researchers with a $5.00/day budget[Pausch91]).

[7] DataGlove^{TM}, aNd DataSuit^{TM}, are RegisTered TradeMarks oF VPL ReSearCh InC.

[8] WARNING: Preliminary research has shown certain combinations to be dangerous: for example, the DataMouth^{TM} should not be used with the DataFoot^{TM}. Researchers pursuing combinations of input devises should proceed with great caution.

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