THE DATA EGG: A NEW SOLUTION TO TEXT ENTRY BARRIERS

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ABSTRACT

A unit that allows text entry with only one hand has been developed, and holds the promise of allowing computers to be truly portable. It is unique in that it allows operation in any position, freeing the user from the traditional constraints of having to be seated near a desk. This handheld, chord-key-based unit can be used either autonomously for idea capturing, or tethered to a personal computer and used as an auxiliary keyboard. Astronauts, journalists, the bedridden, and anyone else normally barred from using a computer while on the job could also benefit from this new form of man-machine interface, which has been dubbed the "Data Egg".

INTRODUCTION

As computers continue to shrink in physical size and grow in raw CPU power and memory, a new problem has been thrust upon designers within the last five years: traditional keyboards dictate that the unit must retain the minimum physical dimensions of the keyboard, lest the keyboard becomes unusable. In short, the packaging becomes the machine's own I/O bottleneck. Examples of this limitation can be found in today's popular "pocket organizers", such as the Sharp Wizard, the Casio B.O.S.S. and Hewlett Packard's HP 95LX palmtop PC. In all these units, the inadequate keyboards severely curtail access to their otherwise powerful features.

Many attempts to attack the problem of general keyboard inefficiency have been made in the past, most notably by IBM who developed a new method of text entry for the stenographer called the Chordian keyboard. In addition, voice recognition, handwriting analysis, and several variations of the Dvorak keyboard (which re-arranges the letters in a standard QWERTY keyboard so that the most common letters are actuated by the strongest fingers) have all been studied.

Most of these keyboard alternatives do not address the newest technology-induced problem: how to insure that a computer's accessibility is not proportional to its size.

A UNIQUE SOLUTION: THE AgendA

One solution to the input problems of these smaller computers came from a firm in the UK called Microwriter Systems, plc. They've created a unique 'personal organizer' that could be operated with one hand. The device, called the 'AgendA', was similar in function to the popular Sharp Wizard and Casio B.O.S.S. organizers, and attempted a brilliant work-around to these products' biggest deficiencies: their tiny and unusable keyboards. (Figure 1.) The AgendA possessed seven large buttons (three for the thumb, one for each of the remaining fingers). Pressing different combinations of these buttons resulted in the generation of all characters, numbers, and commands necessary to enter and extract information. The alphabet was easy to learn, thanks to clever mnemonics and other memory jogs which associate finger position with the character's shape (see Figure 2).

The AgendA's biggest problem was that its design needlessly anchored the user to a desk and a chair, a

fault shared by the rest of today's text-entry schemes. Despite its small size and portability, it cannot be used extemporaneously while walking, driving, or other times when thoughts pop into users' heads. A solution to this long-standing problem sprung up last year when I proposed a version of the AgendA that didn't require a flat surface. Basically, the seven-button scheme was kept intact and wrapped around a shape that was easy for the hand to hold, such as an egg.

The resulting solution, dubbed the 'Data Egg', turned out to solve many problems unaddressed by today's technologies. When used by itself, it can capture ideas that pop up while in transit - ideas that would normally evaporate by the time one got around to writing them down. When attached to a PC and another display device, it can provide a superior computer interface to those who are bedridden. The resulting 'Bedridden Workstation' has also been prototyped, and is described later in this article.

To date, two working versions of the Data Egg have been constructed. The software which drives it accommodates both the autonomous and tethered modes described above, and provides a general framework for application expansion.

THE EGG EVOLVES

The original Data Egg idea took a plastic Easter egg and glued seven buttons and a strap around it, a device custom-tailored to my hand (see Figure 3). After months of typing on it, the egg-shaped device soon was deemed too bulky and the strap, although helpful, was a nuisance. The newer version resembles a beeper, and is worn on the belt when not in use, always handy.

Autonomous Mode

Often while working on important projects, one of my biggest frustrations would be that, at the most unpredictable times, my already over-burdened mind would come up with the infamous "Oh, one more thing..." or "Whoops! I forgot to...". These thoughts usually occurred during inconvenient times, such as while driving or walking to and from the office. The big irony was that during those times I had a laptop computer close by in my briefcase, but I couldn't access it because I wasn't sitting down and immobile.

Using the Egg's Autonomous mode, it is possible to capture just about any idea regardless of the activity. The user's eyes never have to leave what they're doing. When a mindstorm occurs at three in the morning, the Data Egg allows the semi-conscious mind to record thoughts with a minimum of movement and effort, something not possible with pen and pad.

After a year of practice, my "typing" speed on the Data Egg has hit an average of 30 words per minute. While this can in no way compete speed-wise with conventional typing or talking into tape recorders, it does provide a silent and non-burdening alternative to these standard solutions.

I have personally used the Data Egg in the field for over 18 months to capture my random ideas as well as important factiods that come up in conversation. It also allows me to type complete memos and letters during my otherwise monotonous commute to and from home.

Bedridden Workstation

The other Data Egg mode, 'tethered', provides for the Bedridden Workstation, and allows those lying down to have complete access to a standard PC and all the software it runs. The idea was inspired about two years ago when a fellow programmer had back trouble and wasn't able to use a computer until he recovered.

Using a computer while lying down is a pain. The head must be propped up by a pillow to see the screen,

and the keyboard has to rest on the user's stomach, which requires the hands to type at incredibly fatiguing angles. Realizing that it shouldn't be necessary to have a healthy back in order to use a computer, the environment illustrated in the top of Figure 4 was envisioned.

The Bedridden Workstation is formed by tethering the Data Egg to a larger computer, and incorporating an innovative display device (described below) for full-screen feedback. In use, text is typed in with the hand lying comfortably at the user's side, while a TSR (Terminate and Stay Resident) program on the PC takes the ASCII and function codes generated by the Data Egg and "presses" the appropriate character on the computer's keyboard. The TSR program, written in Turbo Pascal, is general enough to allow popular software like Wordperfect (which uses obscure ALT- and SHIFT-Fn key combinations), Lotus 1-2-3, Procomm, and Framework to be used by remote control.

The key component to the Bedridden Workstation is the Private Eye display device. Rather than placing a CRT in front of the user, the Private Eye instead places a small box an inch in front of the user's eye, which projects a virtual image of the PC's screen that "hovers" about five feet in front of the user (but remains invisible to outside observers). When combined with a PC and the Private Eye, the Data Egg allows the user to perform information editing in addition to the information capturing possible in Autonomous mode. This combination of peripherals finally allows the bedridden to have comfortable access to the PC and all of its software.

CONSTRUCTION AND EVOLUTION

As previously described, the first working Data Egg model consisted of a plastic Easter egg and an elastic strap to secure the egg to my hand while typing. A small cable took the pushbutton signals to a small, battery-powered single-board computer, which wasn't quite small enough to fit inside the egg.

Although this setup made for a convenient development environment, some of the egg's drawbacks soon surfaced. The elastic strap made it easy to type while lying down, but also made it difficult during everyday life to quickly put on and take off. This is good for certain applications, but to create an instantly accessible tool, it became clear that a new design without a strap would be necessary.

The Egg also had another problem: the shape was far from universal when it came to accommodating different hand sizes, and could be used only by those who were right-handed. These two drawbacks would be disastrous if such a one-handed text entry product were to become a viable commercial product.

Clay models

About a dozen clay prototypes of shapes were created to try to solve the problems of accommodating two hands without a strap, and yet be just as comfortable to use. Figure 5 shows some of the shapes which emerged from the brainstorming phase.

One of the experimental shapes didn't rely on fingertips at all, but rather was actuated by the first joints of the fingers (plus two buttons for the ball of the thumb). This meant that a smaller shape could accommodate a larger diversity of hand sizes, and make the device both easier to hold and less cumbersome to carry. The clay model demonstrating this concept eventually led to the development of the "Data Beeper", shown in Figure 6.

The Beeper Hardware

The Beeper consists of a hollowed-out Motorola pager, with finger buttons along its long edge and three buttons on top for the thumb, one of which is actuated by the thumb's first joint. All of the buttons have been physically customized to some extent, giving just the right "feel" and travel to ensure that the beeper

could be securely held without accidentally typing a character.

Inside the beeper is an 8051-derivative CMOS microprocessor, 32 KB of battery-backed, non-volatile RAM, an analog-to-digital converter for checking supply voltage, a serial port, and two LEDs for local feedback. Located on the top plate of the unit, these LEDs indicate battery strength, confirmation of commands, and acceptance of text input. Because society instills a great deal of power in personal pagers, the beeper version of the Data Egg also includes a "beeper", an audio oscillator that emulates the personal pagers and empowers its owner to escape boring meetings.

The only thing missing from the beeper design is the inclusion of a liquid crystal display for local feedback; this was left out of the first prototype because of space constraints and the extra software complexity it would entail. It will definitely be included in the next version.

Normally, when the device is being carried, it is only used to generate ASCII text. The alphabet has been expanded, however, to include every character and key combination recognizable by the BIOS of an IBM PC for the times it is tethered to a desktop computer. (To bypass the 128-character limitations inherent in the seven-button scheme, some of these combinations are achieved via two-keystroke commands.) Six additional commands are responsible for switching modes, dumping text to the built-in serial port, clearing memory and running diagnostics. An on-board analog-to-digital converter also keeps track of the battery's voltage, and gives about a week's worth of warning before it goes "dead" (below 5.2 volts) by flashing either a red or green LED during power-up.

WHY NOT A TAPE RECORDER?

The Data Egg has a few advantages over using a pocket tape recorder, which is the current tool of choice for people who work in creative fields:

- No transcribing is needed to achieve paper output (although the text often has to be polished once downloaded to a PC),
- Can interface directly to a computer (when tethered to a PC, as in the Bedridden Workstation),
- Discreet operation. The user doesn't call attention to himself while at the symphony.

The problem of sorting the idea fragments once they get downloaded into a PC is greatly aided by a software package called Lotus Agenda (not related to the original Microwriter AgendA from which the Data Egg idea came.) It automatically searches the input stream and recognizes notes to make calls, meet with people, and even picks out familiar names. It then allows all this linked information to be sorted and viewed in many different ways. The two make an ideal team for taking scraps of thoughts and turning them into useful lists.

In the long run, I believe that voice input, coupled with computer conversational skills being developed by linguist researchers worldwide, will be the ultimate in "intuitive" and friendly user interfaces in the future, with no typing skills to master and no narrow command sets to memorize. The Data Egg is not meant to compete with voice recognition technology. Rather, I see it as a useful complement to facilitate the quiet capture of ideas while away from the workplace.

FUTURE PLANS

There are many other features that an ideal computing companion should possess, but which modest fabrication resources preclude. Some of the items on my wish list, in order of importance, include:

Incorporate a multi-line LCD screen for local feedback.

- Embed a speech synthesizer chip, which would provide speaking-impaired individuals with a text- or phoneme-based synthesizer that is not bulky and cumbersome as are today's offerings.

- An improved shape which is operated by the first joints of the fingers (and the ball of the thumb); this would make it easier to hold, smaller, and more likely to accommodate different hand sizes.

- Integrate a mouse function into the hand-held device as shown in Figure 7; it will then be possible to operate mouse-based applications with just one hand instead of three.

- Software improvements:

  - Password protection for secure files.

  - Routine for pocket modems. The user should be able to hook the Data Egg to a phone line and have it automatically log in and download your notes to your main computer.

    - Clock/calendar/alarm; which would provide standard alarm/programmable timer functions in addition to the current ability of providing a date and time stamp on all data dumps.

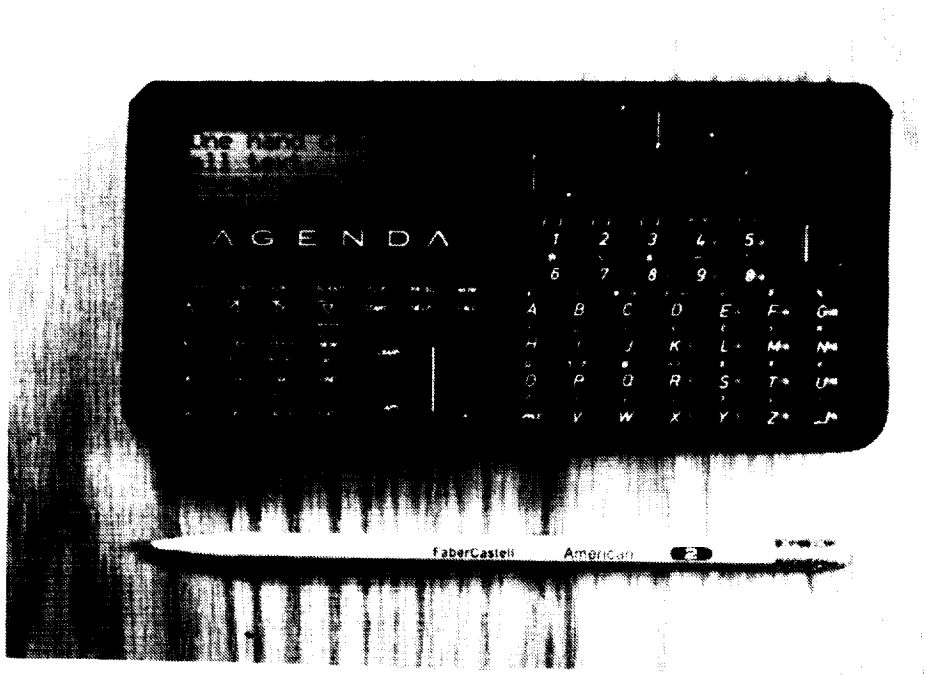
    - Far future: When memory becomes even denser than it is today, the Egg's information capturing abilities should be expanded to include digitized voice recording and, with the inclusion of a lens and charge-coupled device array, a point-and-shoot electronic imaging camera. The ability to capture text, sound, and images would make it the dream tool of a journalist or anyone wishing to easily document the times of their life.

CONCLUSION

Over the past year and a half, the Data Egg's Autonomous mode has become as important for me as the pocket tape recorder is for poets, producers, and those in other creative professions. About 90% of its value lies in its instant accessibility, the other 10% in its discreetness of operation.

Let me emphasize that I am not of the mindset that "every spare minute must be filled up with something productive or I'll explode". Mentalities like that only serve to raise blood pressure and reduce the quality of life outside the office. The Data Egg is driven by quite the reverse philosophy: If your mind is going to be racing with a billion ideas anyway, it would be a waste to allow them to evaporate. As long as my brain insists on coming up with important thoughts at inconvenient times, I will continue to want such an idea-capturing device at my service.

- The research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. Special thanks to Jeff Shaw from the Art Center College of Design for his work on the more marketable shape.



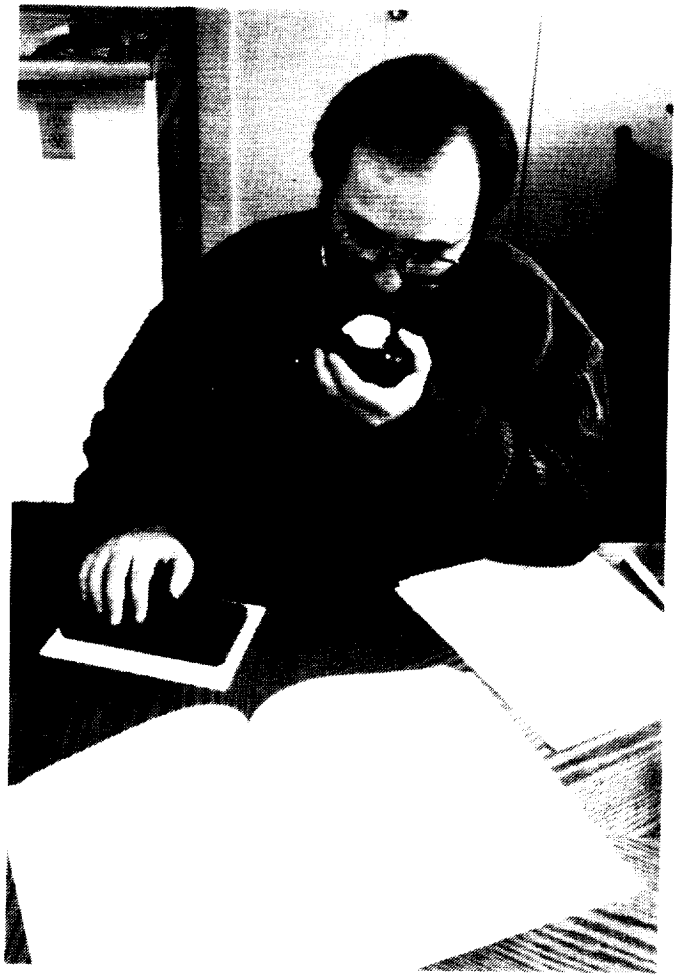
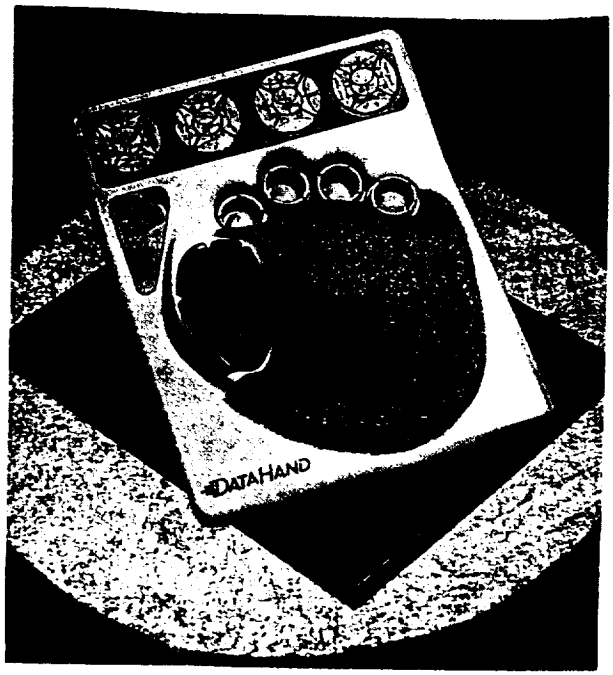


Figure 1
The AgendA's (above) method of typing allowed simultaneous support of scholarly and culinary activities. All single-handed solutions to date (including Industrial Innovations' experimental "Data Hand", below) share the same arbitrary limitation: they can only be used while sitting down.



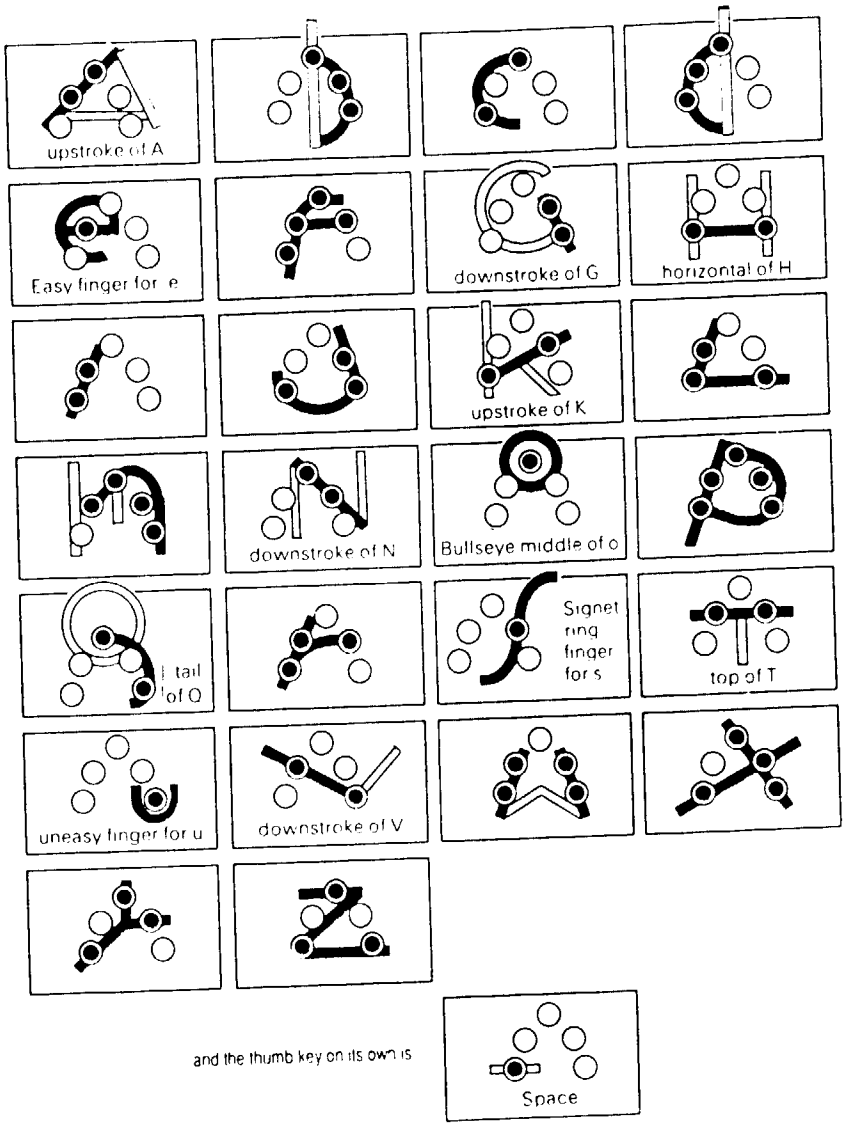
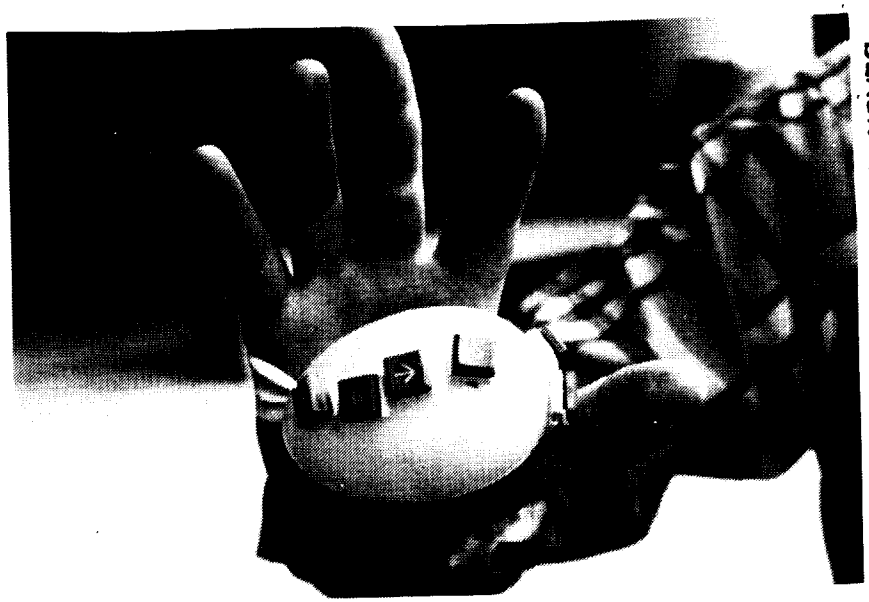


Figure 2
A sample of the Microwriter Alphabet



ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

Figure 3
The Data Egg, a one-handed text entry device, consists of seven buttons wraped around a shape that's easy for the hand to hold. Pressing different combinations of these buttons (three for the thumb, one for each of the remaining fingers) allows typing in any position, free of the historic positional constraints of desk and chair.

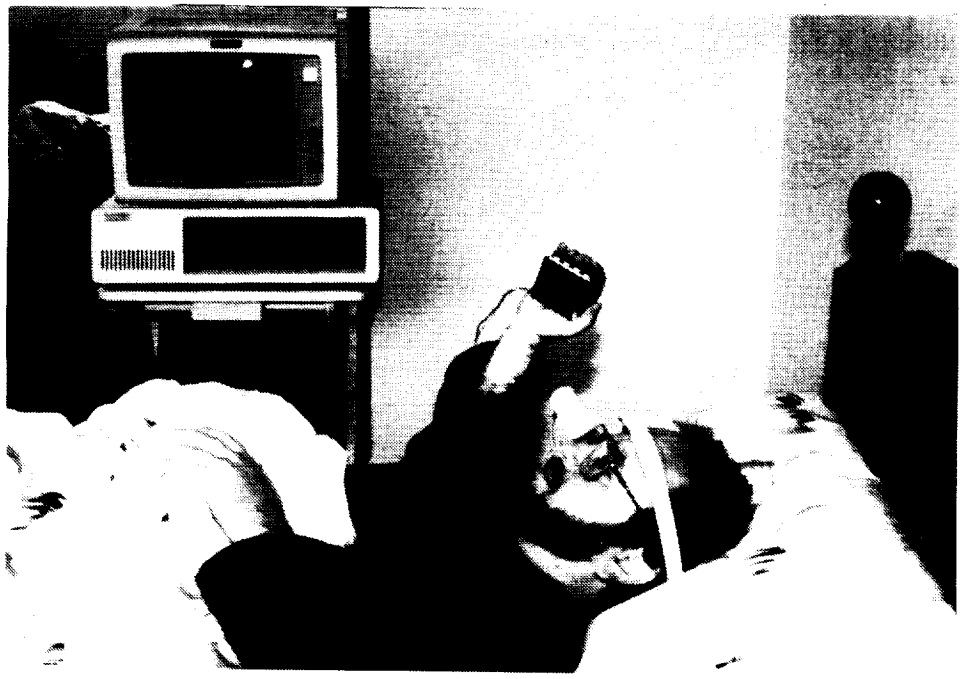


Figure 4
A computer workstation for the bedridden emerges when the Data Egg is combined with a virtual display device called the Private Eye. Text is typed in via one hand lying at the user's side, while a TSR (Terminate and Stay Resident) program on the PC "presses" the appropriate character on the computer's keyboard. The Private Eye projects a virtual image of the PC's screen which "floats" about five feet in front of the user. The resulting Bedridden Workstation allows those with back problems to have complete access to any commercial software for the PC.

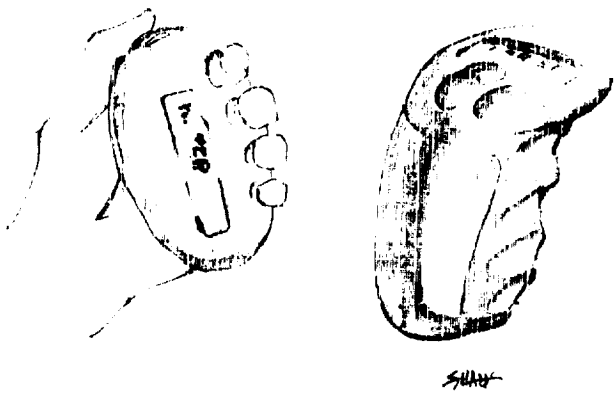
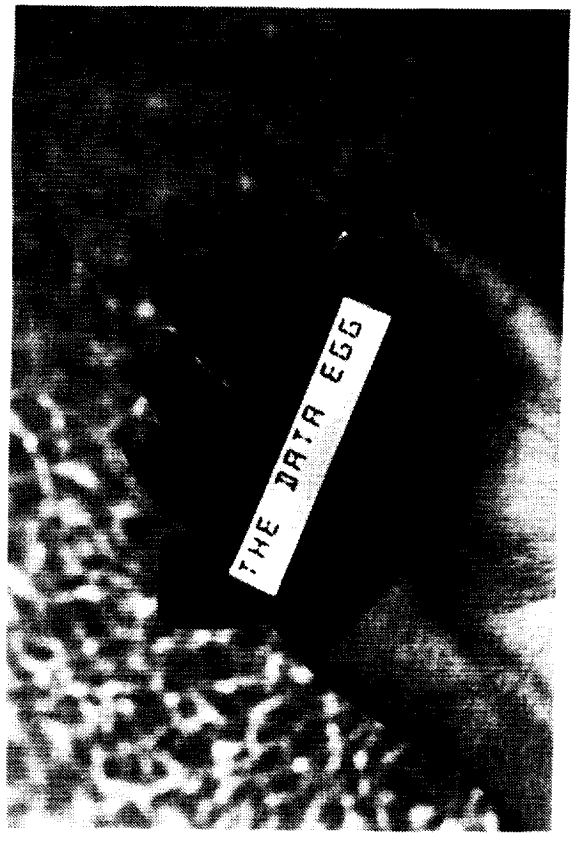


Figure 5
Examples of shape ideas resulting from the brainstorming phase.

(Drawings and fiberglass model designed by Jeff Shaw, Art Center College of Design.)



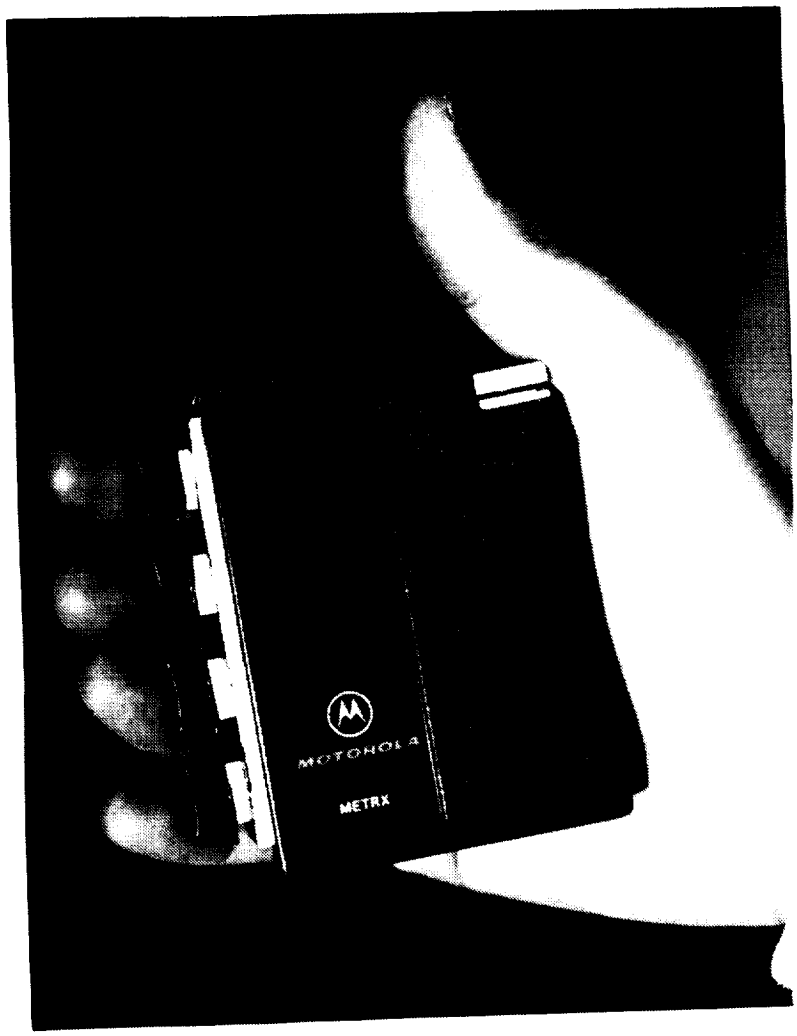


Figure 6
A functioning prototype of the Data Egg is disguised as a beeper, which is a socially acceptable device to carry. Inside the unit is an 8051 microprocessor and 32K of non-volatile RAM, which can capture text and download it to a computer via a bult-in serial port. Because of its enhanced portability, the Data Egg can capture ideas wherever the user might be; ideas that would normally evaporate while walking, driving, or resting.

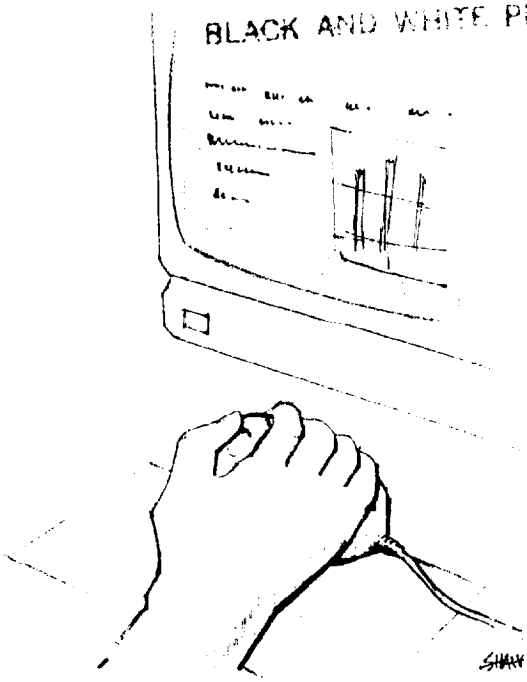


Figure 7
Data Egg/Mouse hybrid allows the use of a graphical user interface with one hand instead of three.

Figure 8
The Data Egg promises new freedom for text entry and computer access.