Designing Computers With People in Mind

Anne Garrison
S. Joy Mountford
Greg Thomas

Well aware that good interface means more than good code, S. Joy Mountford, manager of the Design Center in Apple's Advanced Technology Group, initiated the Interface Design Project to encourage university students from different disciplines–primarily cognitive psychology, visual design, computer science, and industrial design–to collaborate on interface designs. The Interface Design Project was itself an interdisciplinary effort involving Joy Mountford's Human Interface Group in Advanced Technology, Bob Brunner's Industrial Design Department, and some of the company's Higher Education Marketing Departments. They required the students to submit not only their finished prototype project designs, but also their account of the design process and their iterations, including user studies and user testing. The sponsors wanted them to learn "user-centered design," designing products with real people and real tasks in mind.

The project brief also required the students to design interfaces that could adapt to environments beyond the desktop and to individuals with unique skills, goals, and work habits. "The computer I use today knows me no more than it did yesterday or last year," says Mountford. "We asked the students to show us how a computer might adapt to me as I work with it, or how I might adapt it myself."

After a semester's work on Apple-donated equipment and intermittent visits from interface designers, students from nine universities submitted twenty-five projects. These were evaluated by Apple reviewers as well as Austin Henderson (Xerox PARC), Mike Nutall (IDEO), and Kristee Rosedahl (independent designer).

Six months later, the most outstanding student teams presented their designs. Their prototype products included: a personal organizer, shopping aids, educational toys, new desktop computer interfaces, a personal digital assistant for exploring and studying nature, and a computer aid for the handicapped. Among the best projects, all for different reasons, were GloBall, HandiBoard, and Rosetta.

interface 93 design project

About the Authors

ANNE GARRISON *is a writer and editor for technology magazines and corporations.*

GREG THOMAS *works in the Design Center in the Advanced Technology Group at Apple Computer, Inc. and is the Project Coordinator of the Interface Design Project.*
email:Thomas.G@AppleLink.Apple.com

S. JOY MOUNTFORD *is Manager of the Design Center in the Advanced Technology Group and directs the Interface Design Project at Apple Computer, Inc.*
email: S.Joy@AppleLink.apple.com

GloBall, a toy that adapts as children grow.

At the University of Toronto, an interdisciplinary team began by considering a young user, Iggy, whose pushy Uncle Byron had presented him with a computer for his first birthday. Iggy tried it for a while, but when all was said and done, he really preferred his other toys. Was there no computer interface more suitable for Iggy or other small children? The students decided that no one needed an adaptable interface more than small children like Iggy, who explore more of the physical world and learn new words and numbers every day. They designed a prototype project called GloBall, a ball that rolls on its own power, chasing or running away from a child, and plays arithmetic and language skill games.

Iggy could play games by pressing colors, shapes, and icons on Globall's touch-sensitive LCD screen, which would actually be a collection of LCD rectangles. The LCD screen would surround a foamy section protecting the ball's internal components: a CPU, a rechargeable battery, and a motion mechanism which would change the ball's center of gravity, allowing it to move on its own. When not rolling about, GloBall would sit in a base with a battery charger and a disk drive or PCMCIA slot. Iggy's parents would insert diskettes into the drive when

Iggy wanted to play games with GloBall.

What sort of game could GloBall play with Iggy while he was still a crawling infant? The very simplest. Rolling toward and then away from him, it would adapt to his position and his increasing speed and coordination. As Iggy grew bigger and brighter, he could press on GloBall's surface, matching colors and shapes and pictures of animals in response to both visual and audio cues.

GloBall prototypes

University of Toronto students needed to user test Globall without building an actual prototype with the hardware specified in their design—touch-sensitive LCD screen, CPU rechargeable battery, motion mechanism, and battery charger with disk drive or PCMCIA slot. They made the "rolling ball" by sealing a battery-powered remote-controlled truck inside brown cardboard plant pots shaped into semispheres. To make the "talking ball," they sealed a battery-powered, foam-encased baby monitor inside paper mache half-spheres.

When Iggy's parents pressed on GloBall's surface to input his name and age, GloBall would create a user profile, which would soon include his ability to differentiate colors, his response time to different stimuli, and the number of images he could handle at once. In the color matching game, red, blue, and yellow squares would glow on GloBall's surface, and GloBall would ask him to press on each color in turn. Once he was able to identify all three, GloBall would automatically display a more challenging array of colors. In the shape matching game, GloBall would challenge him to press rectangles and triangles only after he had learned circles and squares.

Once they'd created the GloBall design, the students considered the challenge of user testing. Since producing a real GloBall prototype wasn't economically feasible, they built two different balls for testing on little users. One, made of paper maché, contained a remotely controlled car that made the ball seem to move on its own. The other contained an intercom system that made it seem to speak.

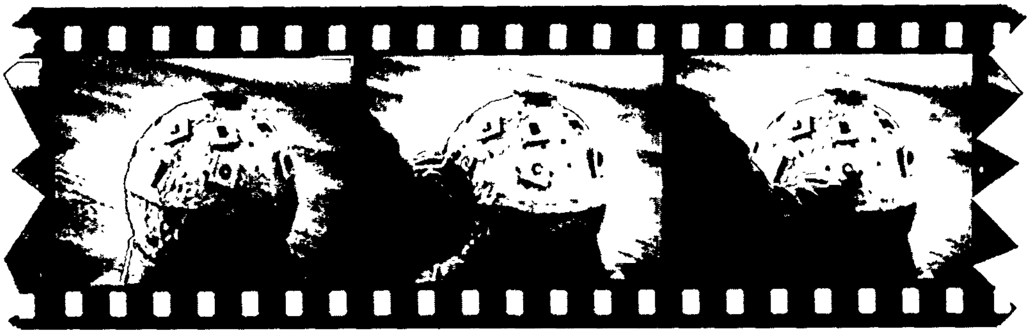
Though the students had worried that children might be frightened or confused when GloBall talked to them, most children liked it and many even seemed eager to engage GloBall in conversation. A young user named Jacob spelled his name "Jacba" on the ball, and then promptly chastised the ball for mispronouncing it.

It also became clear that children might not always interpret language as adults might. When a GloBall prototype challenged one child to press on blue and he pressed on yellow, GloBall said "try again" and he proceeded to press yellow again and again, each time GloBall said "try again." A stronger case for knowing your users and user-testing your designs could hardly be made.

HandiBoard, a computer aid for the physically handicapped.

Five computer science and engineering students from Stockholm, Sweden's Royal Institute of Technology joined a visual artist from Sweden's Royal College of Arts, Crafts, and Design to design the HandiBoard prototype after interviewing handicapped people in hospitals, workplaces, and homes. Their user interviews had led them to two conclusions: first, that there are lots of types of mechanical aids for handicapped people but that most aren't easy to use; and second, that most tools for the handicapped assist with work rather than home life and communication. They decided that handicapped people needed a simple

"Rolling ball."
Remote-controlled truck inside the ball created the illusion that the ball was moving by itself as it chased or ran from the child. Supports fashioned from a metal clothes hanger prevented the truck from toppling onto its back while inside the ball. One of the University of Toronto students conducting the test hid behind a couch with the truck's remote control. The students concluded that: Children enjoyed playing with a ball that rolled independently. A belt would make the best transponder for enabling GloBall to identify the user. The children tested did not respond well to wearing a wristband, neckband, or clip-on.

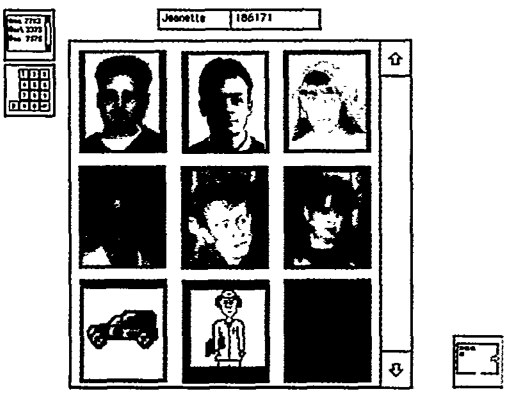


"Talking ball."
The child played with the "talking ball" in one room while, in another room, one of the University of Toronto students watched the test on a television hooked to a hidden camera and used the baby monitor to talk to the child through the ball. The camera also recorded the test for future study. While playing arithmetic, language, color, and shape games, the child made selections from cardboard icons attached to the ball's surface with velcro strips. The students concluded: Children were overwhelmingly responsive to vocal feedback. The touch screen posed no problems, as the children pushed icons quite happily. GloBall would need to be stabilized during games that develop mental rather than manual skills. Design solution: a ring was developed for GloBall to rest in when not rolling or recharging in its base.

computer to help them in their daily lives and living environments. They also identified four tasks handicapped users most often need help with:

- calling for emergency assistance,
- communication with others,
- mobility and the ability to move objects,
- and remembering to keep appointments, take medications, and perform tasks.

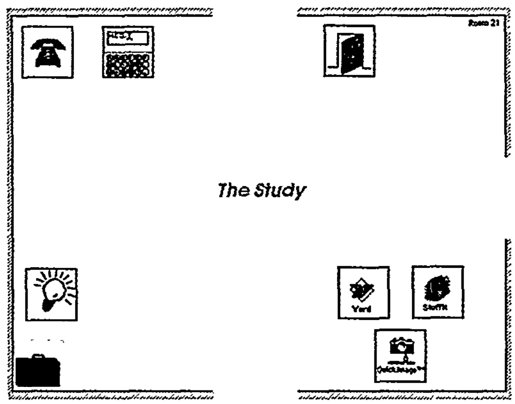
After studying the varied mobility and motor control of handicapped people, the students decided that the HandiBoard should be a thin computer screen, attached to the arm of a wheelchair, that could be picked up and moved from place to place by individuals with control of their hands and arms, or suspended above the head or before the eyes of a totally paralyzed person. With current technology, those paralyzed from the neck down could wear a headset with a transmitter sending signals to a receiver connected to the HandiBoard. A headset transmitting sucking and blowing signals is also pos-



Telephone calling screen.

This telephone calling screen would appear when a user clicked on the telephone icon in a metaphorical room. Clicking on one of the individuals pictured would automatically place a call to them. The ambulance and nurse icons could be used to call for emergency assistance, and the grey space would be available for the addition of another familiar face or icon.

To touch tone dial, users could click on the numeric keypad icon and then click on the keypad which would appear on the screen. The phone book icon could be clicked to access a phone book screen with numbers that could also be clicked.



Home control screen

Royal Institute of Technology/Sweden students used room metaphors for their interface for the handicapped. By clicking on the study in an overview screen of many rooms, users would bring up this screen with its icons for functions typically performed in a study, such as typing. By clicking on the keyboard icon, they could bring up a screen of a keyboard which they could click on if unable to type in the usual way. Handicapped users with more advanced computer skills could launch standard applications like those represented by icons in the right-hand corner.

The bag icon would carry useful tools—such as those used to call for emergency assistance—that the user wanted to have in every "room" in the house.

In a house with the appropriate wiring, clicking on some of these icons could control not only the metaphorical environment, but also the actual environment. Clicking on the light bulb could turn on the lights, and clicking on the door icon could open or close the door.

sible, and technology now being developed holds the promise of voice recognition for those who can speak and eye tracking for those only able to move their eyes.

What could handicapped people do if violently ill and unable to cry out for assistance? Click with a mouse, move their head, or focus their eyes to select an icon on the HandiBoard screen, triggering a digitized cry for help. What could they do to turn on the lights, draw the curtains, or open the door for a friend? Select more HandiBoard icons. To communicate without speaking, call a cab or a friend? Select again. What could they do to remember to take their medication on time or keep an appointment? Select icons and buttons to program the HandiBoard for audio or visual reminders.

When designing HandiBoard's graphic interface, the students sought to offer users customizable, readily understandable everyday metaphors–icons of rooms, lights, doors, telephones, people, and other recognizable images which they could select to control their environments. To make automatic telephone calls, users could select from images including digitized photos of friends and icons representing services such as taxi-cabs or hospitals. They could dial other numbers with a numeric keypad laid out like a touchtone phone.

Once they'd designed it, the students realized that non-handicapped computer users could also use the Handiboard to control their home environments. This broader home market could make the Handiboard a more commercially viable product, lowering the price of a HandiBoard for the handicapped. Their conclusion demonstrated that designs for the handicapped, or other small groups, can have an impact in everyday situations, and that designers should always consider a wider market, even when designing for a small one.

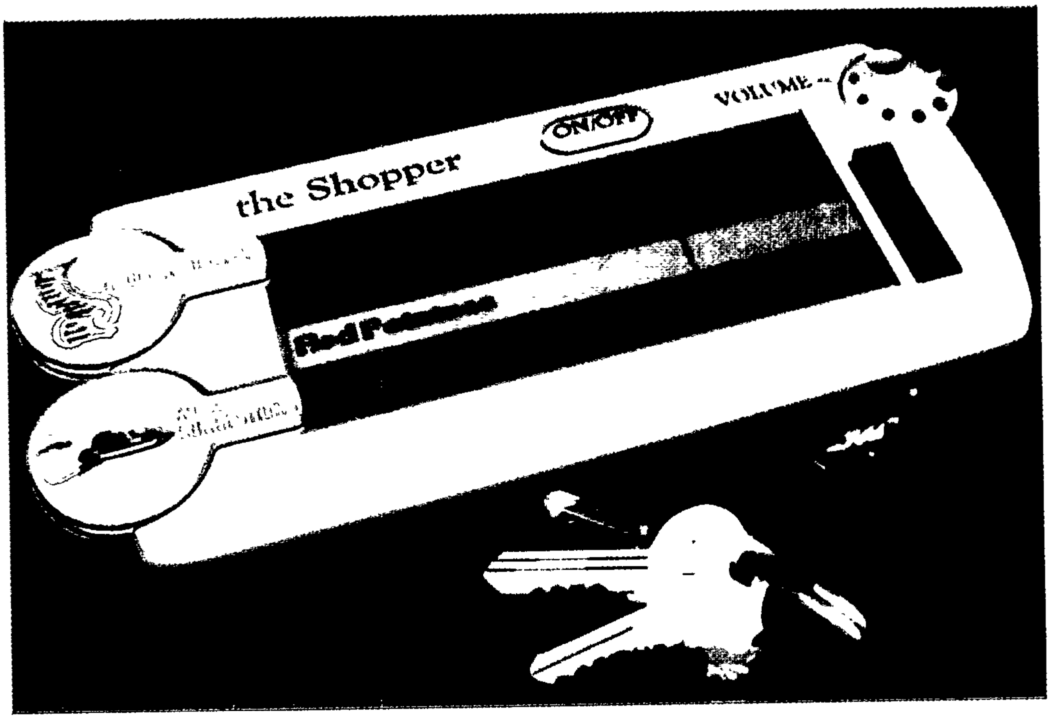
Rosetta

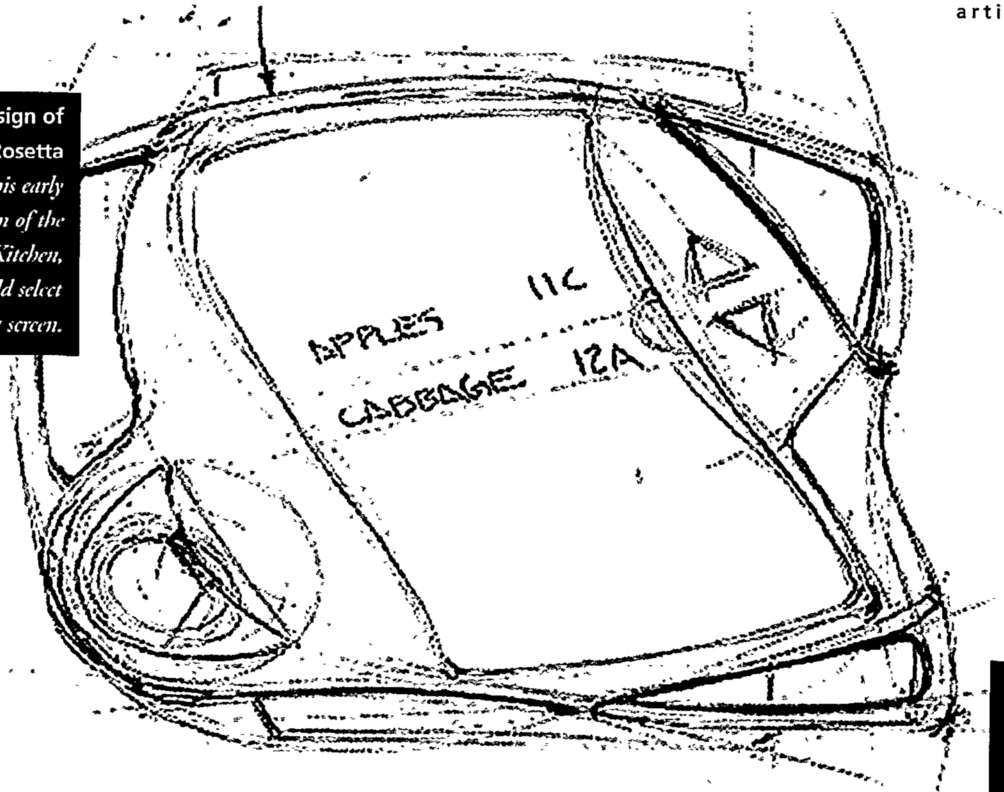
At the Art Center College of Design in Los Angeles, students set out to design a portable, adaptable nutritional manager that would also help people predict and avoid unpleasant inter-

Living Kitchen and Shopper

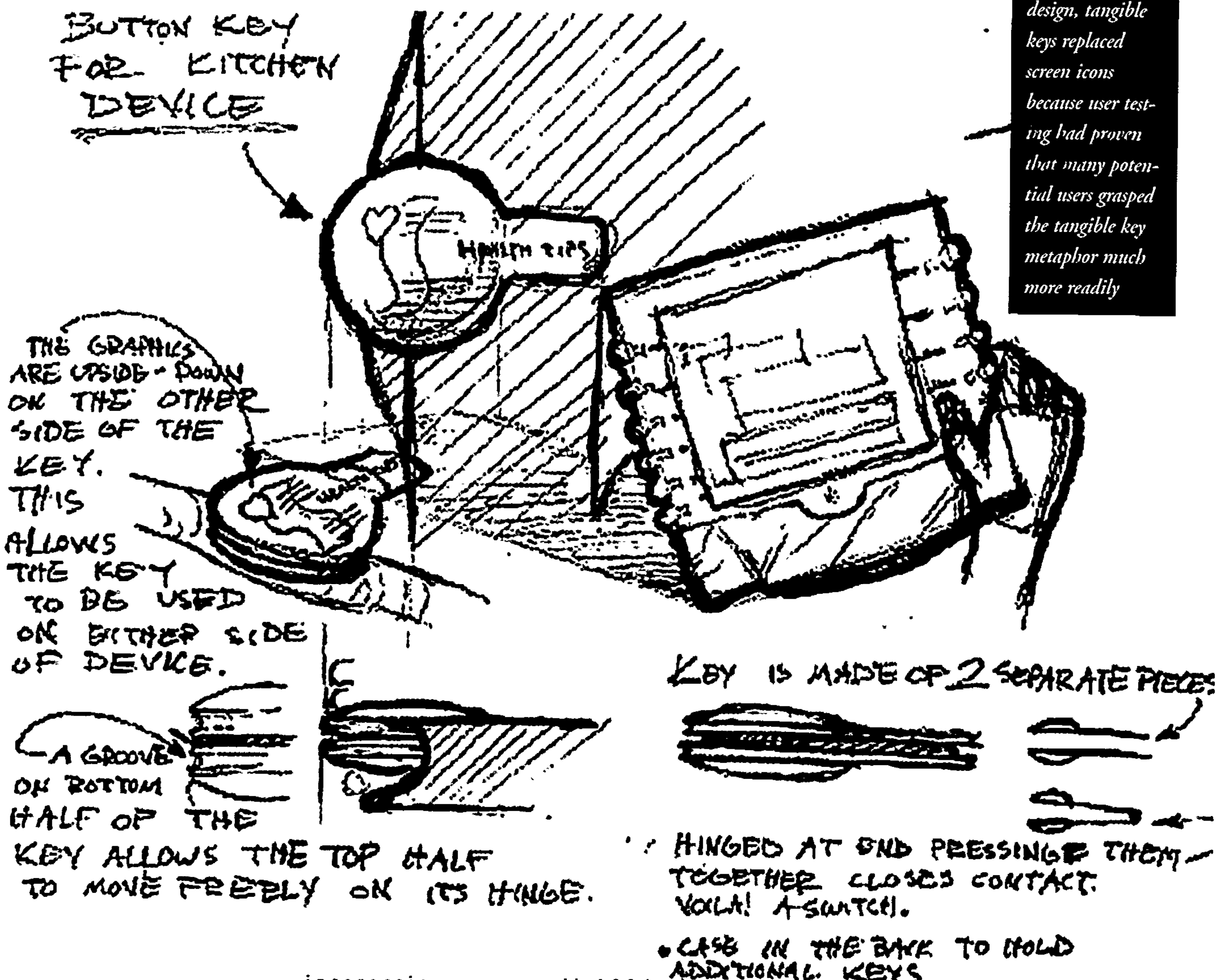
In a likely scenario for using the Living Kitchen, the user would begin by pressing on the Grocery Shopping key. A list of local grocery stores would appear and the user would select one from which to shop. As the user made grocery selections, the systems would analyze these grocery items' compatibility with the users' medical and nutritional needs. The health-related data would be stored at a central database elsewhere, maybe at a hospital, and the user might press on various keys to access this data on-line.

When the user went shopping, they would detach the appropriate keys from the Living Kitchen and clip them onto the Shopper.





Early design of Rosetta
In this early design of the Living Kitchen, users would select icons on a screen.



Later design of Rosetta
In this later iteration of the Rosetta design, tangible keys replaced screen icons because user testing had proven that many potential users grasped the tangible key metaphor much more readily

S. Joy Mountford on the Interface Design Project

Why does Apple sponsor the annual Interface Design project?

We initiated the project to encourage interdisciplinary collaboration between different departments at universities and schools. The project provides students with an opportunity to work on real world problems and gain experience working as members of an interdisciplinary team before they enter industry. In addition, we hope that the 'product' ideas will serve as a creative Whack on the Head for Apple employees by showing alternative and fresh product directions.

How do you select the project topics?

The topics that we select are current, real world issues that are relevant to on-going industry needs. The previous two years topics included designing a family of 'scalable computers' that work together, and the design of 'computers' that adapt passively or actively to different users over time. The current 1994 Interface Design Project topic is redesign of the user interface for the Internet information data highway. We expect students to consider how it may be used as an educational tool by different users, including the elderly or those interested in distance learning. Popular interest in using the Internet means this is a timely topic. The issue facing many companies is how to make this potentially pervasive capability easily accessible for a range of user types.

What motivates the universities to be involved in the project?

They receive an equipment grant from Apple and feedback on relevant industry [illegible] and practices. The students also get an opportunity to add to their vitae [illegible] and to present at Apple Computer. The visual prototypes are interesting material [illegible] about and this added publicity helps develop their career. Apple maintains first right [illegible] make any of the project ideas into a product, if we feel they are viable.

What types of submissions are sent?

The students submit various prototype forms of their future product ideas. These include software prototypes of the user interface and interaction style, industrial design models, and video evaluations of real user feedback collected throughout the evolution of their 'product' concept. The students' ability to document their actual process of design is an important part of the project assessment criteria. In addition, we expect that their interface design will be both easy to use, as well as show exciting new product directions.

What feedback have you received from the faculty and students?

The feedback from all the participating universities is very enthusiastic. Many universities continue their participation without any 'official' sponsorship from Apple, by running courses around the project brief topic. The faculty have been faced with challenges about how to evaluate team project participation, and how to assist in constraining real world problems to help students reach timely solutions. Many students have told us that this Design Project has been the highlight of their course work.

What is Apple's ultimate goal?

Our primary goal is to assist in establishing a core curriculum in interaction design. By helping define this direction, new interaction hires will be better trained to be more effective quickly in the work environment. As the computer business rapidly changes, industry and education need to find new and creative ways of working together. Continued sponsorship of such projects are mutually beneficial, and will result in future products being designed with the real end user in mind throughout the development process.

actions of food and medications. They began by interviewing elderly people, who commonly use one or more medications, and soon learned that they tend to dislike change, especially changing technology. The students concluded that their nutritional manager would need to be not only very useful but also un-intimidating. After user testing a series of prototypes, they also came to the following conclusions:

- •A nutrition manager appealed to people 50 years of age and older and families.
- •Elderly people and people taking medications often have shaky hands, so small motor skills like using a pen should not be required.
- •The nutrition manager needed to fit the shape of the user's hand.
- •Users were confused and intimidated by icon buttons on a prototype's screen. They were not confused and intimidated when the data they could have accessed by clicking on icons was presented as a list that they could scroll through in outline form.

The final prototype, Rosetta, was a pair of hand held devices, the Living Kitchen, for use in the home, and The Shopper, a smaller device for use while shopping for groceries. Though the Living Kitchen was larger, the two devices shared the same simple interface: a screen, a "rocker switch" for navigating up and down lists, a volume control, and tangible "keys" inserted into the side of the device.

The keys were a clever hardware solution that replaced the software–the icon buttons–which had confused users. Test subjects readily understood the key metaphor, especially because the keys were real, tangible objects shaped just like the keys they used every day. They were quick to comprehend that the keys unlocked information, just as they unlocked doors or mailboxes. Though a button that launched an application had been hard to understand, a key that launched an application seemed much like a key that started a car. In the students' design, users would be able to customize Rosetta by purchasing different keys to unlock the types of information most helpful to them. H