Here now: COMPUTERIZED NAVIGATOR FOR YOUR CAR
Electronic compass and motion sensor give pinpoint 50-foot accuracy

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computerized
A new on-board navigation system provides a CRT with scrolling maps that accurately guide you to your destination. An electronic compass, motion sensors, and a "smart" dead-reckoning system continuously update your position to tell you where you are. Wired external transmitters deliver the signals that allow the CRT to map your course of travel. This system has been specifically designed for use in automobiles and is available in a variety of models to suit the needs of today's drivers.
to test two of these early-production navigators.

**Hands-on navigating**

My first experience with the Navigator began with a demonstration ride with Don Warkentin, Etak's marketing director. After instruction from him, I was able to select a destination by myself.

"You don't have to spell the whole name," Warkentin told me. "Just put in the first three letters of the street intersection you want to drive to."

I selected the letters using the "Speller" button next to the CRT. Then I hit the "Select" button, and the screen immediately displayed street names beginning with those three letters. Using another button, I scrolled through the index to find the street I was searching for. (Destinations can be entered by street address or by intersections.) It took me only about 90 seconds to find my intersection and enter it in the Navigator.

Now a map appeared on the screen, and a flashing star showed up at the location of our destination. Our car was represented by a stationary triangle in the center of the map. Using these symbols, it was easy to pick out the best route. As we drove out of the parking lot and turned onto the highway, the map started to scroll, keeping the flashing destination star always ahead of us. The streets, as shown on the map, precisely matched the view through the windshield as we headed in the direction indicated by the flashing star. The symbol for the car itself stayed in the center of the map as though glued there.

Every time we turned at an intersection, the map changed directional orientation. In addition, it showed the vehicle exactly at the intersection, going onto the road onto which we were turning. Honey later explained why the navigation system is so accurate: "The system works on dead reckoning—maintaining a known position through measured courses and distances traveled.

"Still, in dead reckoning, no matter how good your sensors are, they inevitably accumulate error as you drive," Honey said. "What we do is use comparisons with the map data base to recalibrate the sensors, as well as to eliminate the accumulation of error." In the Etak navigation system this happens once every second as you drive. The computer in the Navigator constantly compares distance measurements to distances on the map. If they disagree—perhaps the display shows you making a turn just short of an intersection—it ignores that, for the moment. But when you make the next turn, it will move you to the correct position because the "smart" dead reckoning figures out that you must be at the right spot.

"We've been referring to it as augmented dead reckoning," Honey said. The secret is the navigation algorithm he has invented. An algorithm is a step-by-step set of instructions that makes up a computer program.

Honey cites this example of Etak's augmented dead reckoning: "Suppose you've driven around a particular S-bend, and in the map data base there happens to be a road with an identical S-bend—but the map shows it a few feet over from your position. Well, you'd decide that you're probably on that section of road." That's exactly what the computer does to eliminate accumulated error.

**Lost on the straightaway**

Does the computer ever get fooled? I was shown how it can get crossed up on a ride the next day with Chuck Hawley, Etak's digital-map-production manager. The navigation system's greatest accumulation of error occurs on long stretches of very straight roads, Hawley told me. The reason? The computer needs turns to keep it oriented. (It ignores mere lane changes.) If you're driving straight stretches of road, it has nothing to go on but the compass heading and the measurement of distance by the motion sensors.

The sensors scan strips of magnetic tape mounted on the inside of each of the non-driven wheels. The tape has alternating positive and negative magnetic areas. Once calibrated during the initial system installation, the sensors count wheel revolutions to get a precise measurement of distance. On roads with curves and turns, the computer uses its augmented-dead-reckoning capability to reorient itself. Straight roads give it no opportunity to correct itself.

Hawley showed me how it works. After a straight run of several miles, we were about 30 feet off on the map. But amazingly, after a couple of turns, the vehicle's position appeared right where it should be. If it hadn't, it would have been simple to reposition our vehicle on the map, as Hawley showed me, by moving the car cursor with a button control. It can be done quickly at any stoplight.

Inaccuracy can also creep in through tire-pressure changes or tread wear, which can change apparent wheel size. And there's a need to reposition your vehicle if it ever gets "blindfolded," Ken Broome said: "If your car gets towed or you take a ferry ride, the car probably won't know where it is when you get back on the road." There is no non-volatile memory in the system. Instead, a low-drain complementary-metal-oxide-semiconductor random-access memory stores the vehicle's position. The Navigator draws only one milliamp...
Etak in the marketplace

Etak plans to start selling two models of the Navigator this year: the 700, with a seven-inch screen, and the 450, with a 4.3-inch screen. The $359/$75 each. Map cassetttes will cost approximately $3.85. Sales for the company's first quarter will be through catalog and mail-order companies, with the goal of reaching dealers in 1986.

Bromine estimates that installation of the Navigator will be a $100 service for three hours. The 同样的 will be performed only if the customer's vehicle is in the showroom.

Who will be the likely customer for the Navigator? Bromine says that it is likely that the customer will be the initial car owner. However, the system will be offered to car buyers.

Bromine says that the Navigator is being marketed with a new service package, which includes a subscription to the service in addition to the system itself. The service is a subscription to the navigation system.

Easy reader

I found the Navigator simple to operate. The street names are easy to read, and the system is accurate. I had no trouble reading the screen from my position in the back seat, nor did I have any trouble using the system.

Honey is proud of the hardware in the Navigator, which is the heart of the navigation system. The system is a small computer, with 256 kilobytes of memory. It is able to analyze data from various sources, including maps and the road's own sensors. The system is able to put it together for the user, so the user does not need to know about the different components.

When you're driving, the only control you need to use is the zoom control. The zoom control is used to adjust the size of the map on the display. You can zoom in or out to see more of the map or less of the map, respectively. You can also use the zoom control to switch between different maps.

But zoom in close enough, and only a small part of the map is shown on the screen. It would be the easiest part, but that's enough. We thought that the zoom control would be the best, and that's what we decided to use.

Etak also plans to offer a more advanced system, with a larger map, in the future. The company is working on a system that will allow the user to see a larger area of the map, and to see the map in detail.

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