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920601

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3/11/92

Reprinted from: **Electronic Display Technology and
Information Systems**
(SP-904)

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**International Congress & Exposition
Detroit, Michigan
February 24-28, 1992**

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ISSN 0148-7191

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Printed in USA

90-1203A/PG

Development of the New Toyota Electro-Multivision

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ABSTRACT

This study introduces the most recent version of the Toyota Electro-Multivision system which was equipped on the 1991 Soarer. As in the previous version, the Electro-Multivision is operated and controlled by interactive inputs through touch-activated display panel switches. The key features of the system are its use of the state-of-the art 5.9-inch thin film transistor (TFT) LCD and four improved navigation functions.

The new navigation-related functions are as follows:

1. Two CD-ROM disks incorporating map data on major cities (Scale: 10,000 to 1).
2. Touch activated panel display of maps that can be scrolled with the touch of a finger.
3. A location function that works off a global positioning system (GPS) and map matching.
4. Route Guidance from the present position to a target destination.

BRIEF HISTORY OF TOYOTA ELECTRO-MULTIVISION

Toyota developed the first "Electronic Compass" for automotive applications in 1983. Foreseeing the demand for auto-related information, it developed a system called Toyota Electro-Multivision, equipped with a cathode ray tube (CRT) capable of multiple display of auto information. The in-vehicle system was equipped on the Toyota Soarer models in 1985.

On the Toyota Crown in 1987, two new functions were added to the Electro-Multivision: a compact disk read-only memory (CD-ROM) to store digital map data covering the whole of Japan, and a navigation function displaying the vehicle's position using a self-navigation system. This car navigation system was the first step in providing drivers with key information

based on location using a CRT display. The system's development is traced in broad outline form in Fig. 1.

The present upgraded system has map matching technology and dead reckoning using satellite-emitted waves, and far greater accuracy in displaying road networks. This technology has made it possible to offer navigation function (map display, location, route guidance) display based on detailed map data.

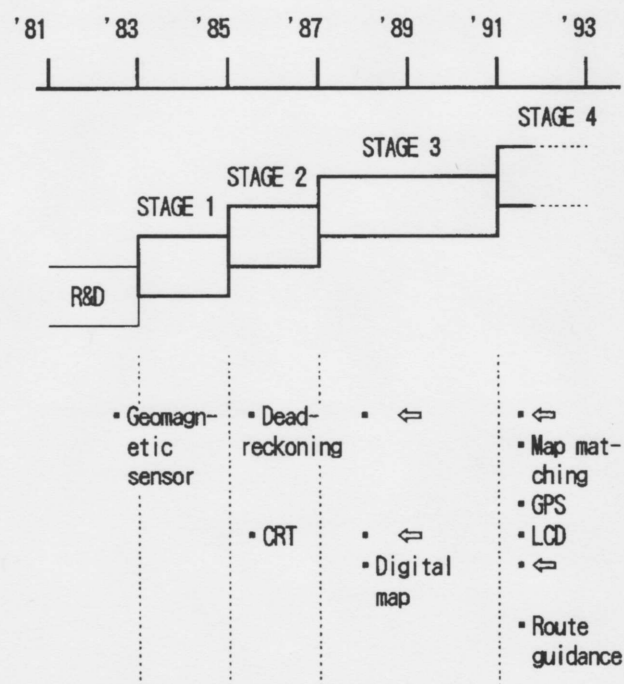


Fig. 1. History of Toyota Navigation System

SYSTEM COMPONENT LAYOUT

The components of the in-vehicle Electro-Multivision system are shown in Fig. 2. As different from the previous configuration, the updated CRT features a thin film transistor (TFT)-type liquid crystal display (LCD). The display computer unit is accommodated in back of the display, with the computer unit housed in the space it was in the earlier CRT display unit. The weight of the unit is now less than half that of the earlier version.

Connected to this display computer are the various system components: sensors, computers, audiovisual system computers and so on.

The block diagram in Fig. 3 gives the bus design for the global positioning system (GPS), TV, radio, air conditioner, car phone and other sub-computers and their communications network involved. Up to 10 sub-computers can be hooked up for more expandible functions. The compact disk read-only (CD-ROM) data are transferred by means of a separate high-speed bus line system.

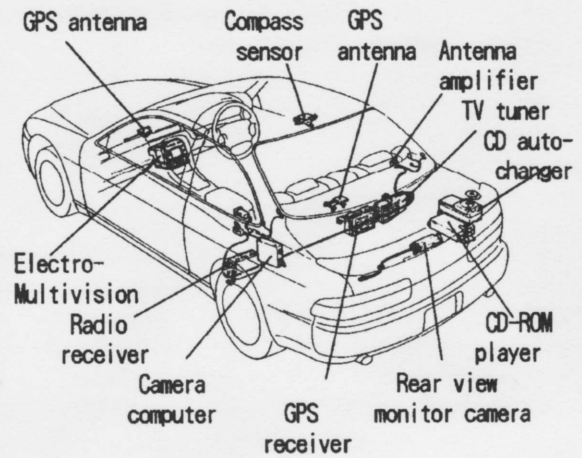


Fig. 2. Electro-Multivision System

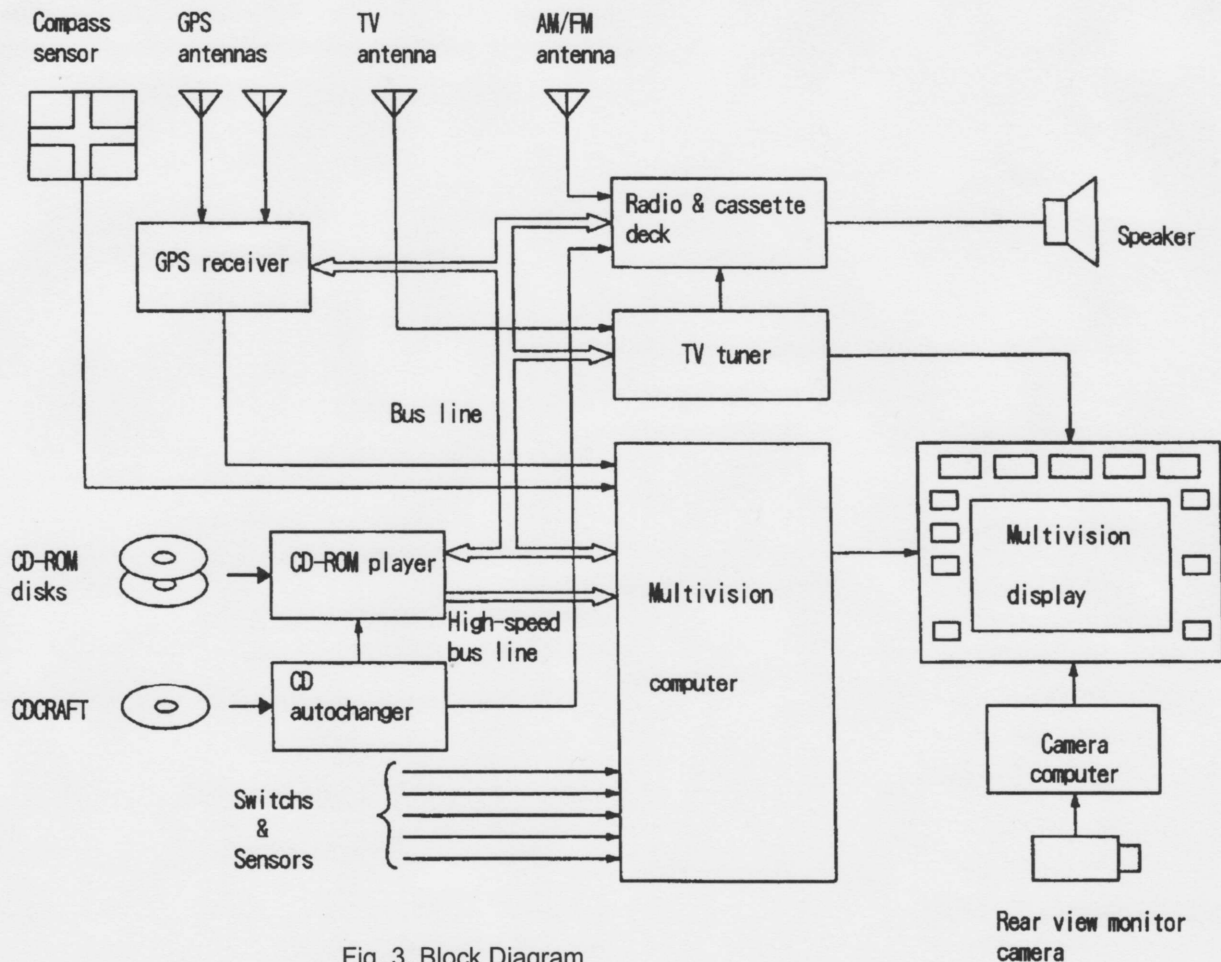


Fig. 3. Block Diagram

The various sensors are connected up in parallel to the display computer: the previous geomagnetic sensors for calculating the vehicle's position and the distance sensors, plus the wheel sensors, steering sensors and GPS receiver. The special CD-ROM player is equipped with two CD-ROM disks that store the digital map data, and it is equipped in the trunk room. There is a diversity-type GPS antenna system. The two antennas are equipped in trays in the front and back of the vehicle interior so as not to interfere with the smooth lines on the exterior. The audiovisual system is basically the same as before. The four TV antenna are glass print types. A CCD camera is carried in the air spoiler in back for rear vision when backing up.

SYSTEM FUNCTIONS

The main functions of the Electro-Multivision system and display examples are listed in Table 1. The system functions incorporating new technology are herewith explained in comparison with the previous technology.

DISPLAY INFORMATION—An automotive display must be readily visible while driving, not to mention arranged for easy recognition, safety and comfort. An in-vehicle display, compared to one for conventional use, must be built to withstand severe environmental conditions such as temperature fluctuations (high and low), vibration and other factors in the in-vehicle environment. The display construction is shown in Fig. 4, while Table 2 indicates the differences with the earlier version. The construction and functional features are outlined in what follows.

In-vehicle Color LCD Panel—The present display employs a diagonal LCD of about 6 inches. This is approximately one inch larger than the previous model (see Table 2). Resolution and brightness are virtually the same.

(1) The position for mounting the display and the Light control filter(LCF) selection were arranged to assure sufficient contrast for good visibility by the driver (see Fig. 5).

(2) For better response characteristic at low temperatures (under 20 degrees celsius), the back of the LCD was stripped with a transparent film heater (see Fig. 6).

In-vehicle backlit—The same as with the previous version (W shape), the new color LCD panel has a backlit screen using a high-luminance cold-cathode tube(Ref. 3.).

INPUT OPERATIONS—There are multiple displays accessible with the touch-sensitive panel depending on the operation mode used. Since all kinds of information can be displayed, they must be instantly accessible to the driver. Thus, as with the former system, a hierarchy of functions is provided with access by mechanical and touch-activated switches (see Table 3).

Table 1. Outline of Function

Type of Screen	Function
(1) Basic screen	<ul style="list-style-type: none"> ■ Air conditioner status ■ Calendar (current month day and day of the week) ■ Audio equipment status
(2) Geographical information screen	<ul style="list-style-type: none"> ■ Map ■ Current location (With GPS) ■ Place name index ■ Route guidance ■ Memory points ■ Storing point
(3) Vehicle information screen	<ul style="list-style-type: none"> ■ Maintenance information (Engin oil, filter, tyre etc,) ■ Fuel economy information ■ Trip information (dairy trip and fuel consumption) ■ Monthly calender
(4) Audio screen	<ul style="list-style-type: none"> ■ Audio equipment status
(5) Air conditioner screen	<ul style="list-style-type: none"> ■ Air conditioner status
(6) TV screen	<ul style="list-style-type: none"> ■ TV broadcast
(7) Diagnosis screen	<ul style="list-style-type: none"> ■ System diagnosis
(8) Rear view monitor	<ul style="list-style-type: none"> ■ Rear view while backing up
(9) Mobile telephone screen	<ul style="list-style-type: none"> ■ Mobile telephone status

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