

Progress of Car Navigation in Combination with In-Car Peripherals

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1. Introduction

Car navigation systems have been developed to assist driving by giving directions to the driver. In recent years, the systems have been developed in combination with electronic apparatuses such as rear-view cameras and entertainment devices such as digital video systems.

This report discusses the challenges for developing car navigation systems focusing on their combined use with such external devices.

2. Car Navigation Systems and Connection of Devices

Today's car navigation systems contain fast, high-performance arithmetic devices, large-capacity memory, and large display screens, so they can also

serve as an on-screen display of the rear-view camera or front-view camera and a HFT (hands free telephone) unit that allows telephone-answering while driving. Furthermore, car navigation systems are increasingly being used as entertainment equipment other than for assisting driving, such as for displaying TV or DVD images, and for storing and playing back music data. Such functions are provided not by the car navigation system alone; they are presented to users by the car navigation system in combination with dedicated devices. The functionality of such services is being improved through combined configurations. Some examples of the functions available through combining a car navigation system and external devices are described below (Fig. 1). Note that some of the external devices, which are now considered independent external de-

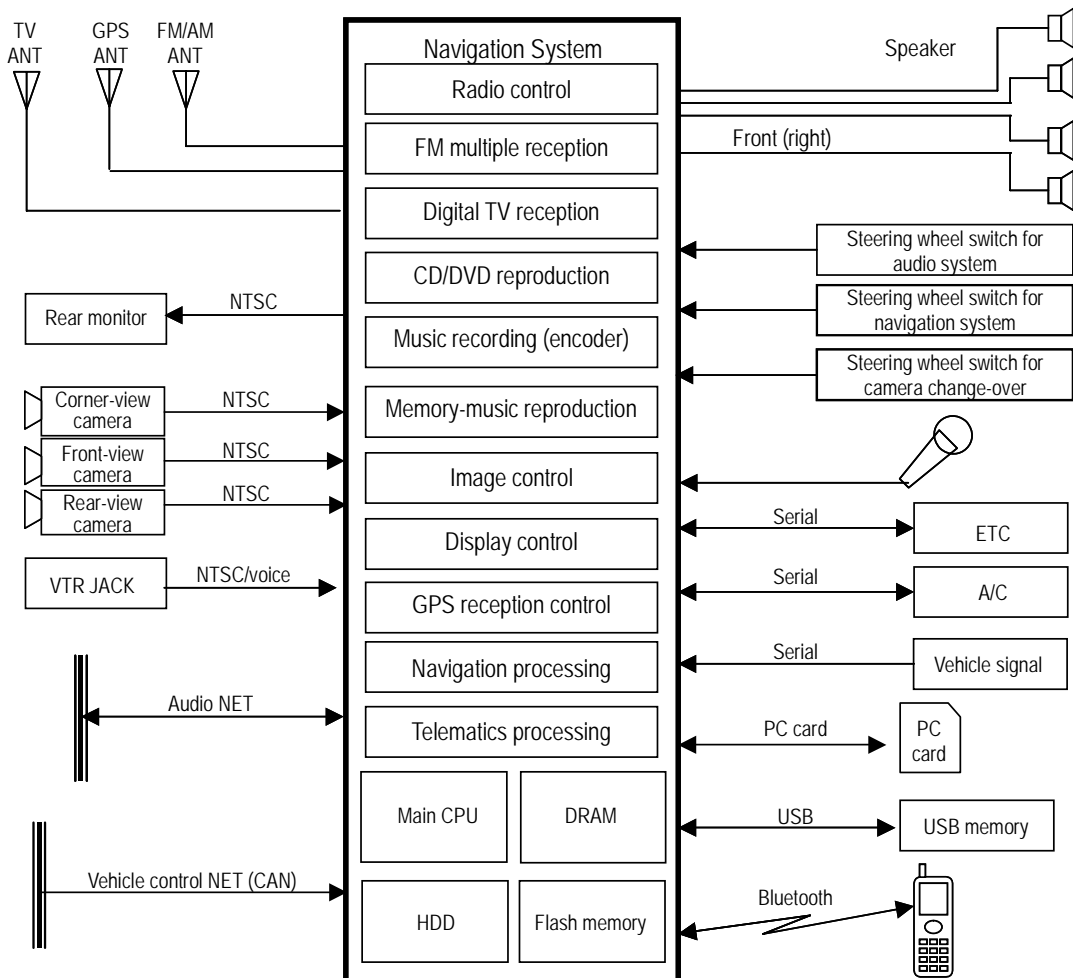


Fig. 1 Block diagram of a car navigation system and peripherals

VICES, may be incorporated into the car navigation systems as component elements as the devices will become smaller or integrated into chips in the future.

3. Combination with Cellular Phones

The functions of the on-board unit related with cellular phones are: the HFT function, data communication function, and address book management function. An outline and the development challenges of the HFT function are discussed below.

The HFT function was incorporated for hands-free cellular phones without having to hold the phone while driving for safety reasons. In the case of a general manufacturer's car navigation system added as an extra, the speech button is usually installed on the steering wheel, to allow the driver to start to talk without taking his/her hands off the wheel.

The driver can hear the voice of the caller output through an on-board speaker. However, the voice is also input back to the microphone to collect the driver's voice. Noises inside and outside of the car also enter the microphone. In short, the caller can hear the driver's voice, and the echoed voice of the caller overlapped with noises, and sometimes the driver's voice is inaudible (Fig. 2). To solve such problems, a noise canceller or echo canceller must be included in the system.

Unnecessary components such as noises and echoes vary with road conditions, vehicle environment, and the characteristics of the microphone or speaker, so tuning must be conducted for each car to remove such components. Also, the unnecessary components may vary with the conditions of the cellular phone system, and are thus very hard to completely eliminate.

For problems that depend on cellular phone conditions, differences in sound volume or performance of HFT support functions as well as the elements mentioned above can also affect the normal operation of the unit. Checking and adjusting system performance takes enormous time and effort.

4. Combination with Music Players

Today's drivers want to enjoy music output from state-of-the-art audio devices, including memory audio players such as USB (Universal Serial Bus) audio units, iPod (registered trademark of Apple U.S.A.) systems, and other portable music players. In conventional methods, the output from the headphone socket of a portable audio system was input to the on-board audio device via external input terminals (AUX), requiring the driver to operate the portable audio system itself to select the music. However, there is demand to hand the switching function to the car navigation system. To control an iPod from an external system, for example, the iPod control process must be uploaded to the car navigation system by using a special interface library provided by Apple. For a USB memory connection, a special control process complying with the USB interface specification must be implemented.

5. Challenges Related with the Increase of Devices Connected to Car Navigation Systems

As described above, an interface is required for each device to be connected as the number of external devices increases. Sometimes the specifications of devices cannot be clearly disclosed in accordance with the External Device Connection Interface Specification. In such cases the interface between the devices must be developed by actual connection followed by actual adjustment, which requires much time and effort.

When a car navigation system is to be connected with several devices at the same time, technologies related with the specifications of the interface between the devices and device characteristics must be developed as discussed above. However, physically speaking, many signal lines are also necessary as shown in Fig. 1. As a result, the rear face of the car navigation system is packed with many connectors and connecting all of them in a conventional manner becomes physically difficult. So many signal lines is a challenge for not

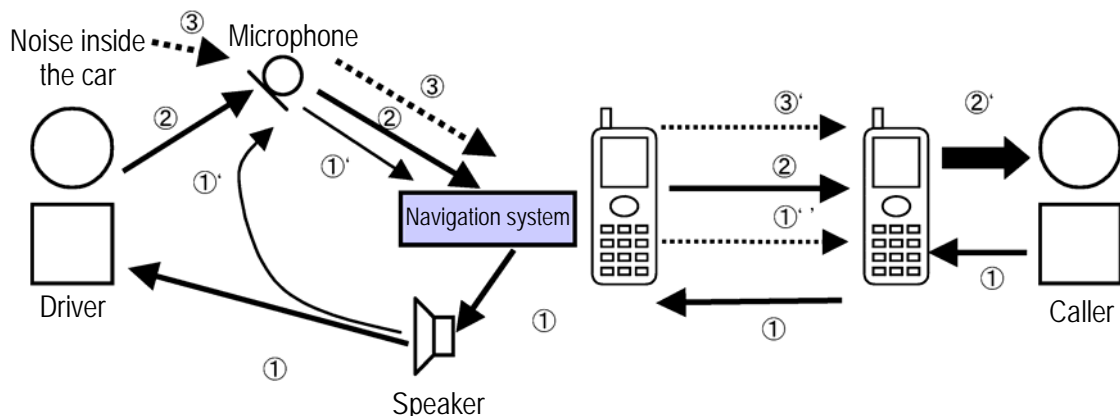


Fig. 2 Noise and echo cancelling

only the car navigation system itself, but also for the whole vehicle due to wiring space, wiring work, and arrangement cost. To solve this problem, high-speed networks such as MOST (Media Oriented Systems Transport) and IEEE 1394 have been proposed for reducing the number of signal lines on board and realizing high-speed data exchange. In Europe in particular, the MOST method has been employed in some applications; however, manufacturers are still studying the feasibility. As a car navigation system manufacturer, we must develop elemental technologies while closely monitoring vehicle development trends.

6. Conclusion

Car navigation was developed to help drivers drive their cars without concerns about losing their way in new places. Safe driving assistance and entertainment functions will need to be improved in the future, and car navigation systems will need to be combined with various devices. Since connecting external devices to the car navigation systems requires work that may not be worthwhile, device interfaces should be standardized and a reference model developed for verifying actual systems.