

# ***i-audio (AI Integrated Unit) Development***

*Koichi Matsuda*

*Syoji Ueoka*

*Isao Hamada*

*Satoru Nakae*

*Shigeo Nakamura*

*Tatsuo Fujii*

*Takeshi Watanabe*

*Yoshinori Kagaya*

*Shigehiko Miura*



## **Abstract**

The increasing popularity of cellular telephones and personal computers in the consumer electronics market over the past few years has been accompanied by an infusion of vehicular on-board electronic systems, both factory installed and optional, from every manufacturer. (Currently, features such as internet connectivity, e-mail, updated facility information, and electronic navigation systems are offered.) However, the majority of consumers do not feel that these systems are worthwhile in the present telecommunications environment given the demands of a vehicular environment (transmission speed, fees, etc.) and with the feature set and price presently offered.

At Fujitsu TEN, we have decided to only pursue consumers who use audio product only and have developed the unit described here (hereafter referred to as "i-audio") pursuant to the objective of bringing to market an on-board system that can be sold at a low price and still offer necessary telecommunications features. The telecommunication services provided by this device are Area SHOT-- a service that enables location confirmation and supplies information on the surrounding area through map transmission; and E-iSERV-- a service that dispenses information from the ECLIPSE dedicated server. This document contains outlines of products and on-board features and information describing the new technology used in hardware/software development.

## 1

**Introduction**

Recent developments in the consumer electronics market, such as the diffusion of cellular phones and personal computers have led to improvements in the telecommunications environment. Under this environment consumers have come to recognize the convenience of obtaining the latest information in real time.

Telecommunications environments for on-board terminals continue to be developed and put on the market. The passenger vehicle market offers an array of products ranging from factory installed devices such as Toyota Motor Corporation's G-Book, Nissan Motor Co., Ltd.'s CARWINGS, and Honda Motor Co., Ltd.'s Internavi Premium Club to aftermarket systems such as Pioneer Corporation's Air Navi, Matsushita Electric Industrial Co., Ltd.'s YOU Navi, Alpine Electronics Inc.'s i-assist NAVI, and AZZEST's (a division of Clarion Co., Ltd.) CADIAS. However, these products are positioned in the market as little more than a combination of conventional navigation and telecommunications features, making them seem expensive in proportion to the services they provide under the current telecommunications infrastructure (communication speed, fees, etc.). Consumers have remained indifferent, believing that these systems add little actual value to the driving experience, taking the new products as offerings by which manufactures show off their technical capabilities.

In order to solve this situation, by combining Audio and Telecommunications features into one product, we at Fujitsu TEN, Ltd. have rejected the price point of conventional automotive telecommunications systems. Our system has been developed pursuant to the goal of offering value-added car audio products complete with telecommunications services including Area SHOT, which used transmitted maps to enable position confirmation and provide information on the immediate area, and E-iSERV, which provides information through ECLIPSE dedicated servers.

The features and technology of this device are explained below:

## 2

**Product Overview**

The following is an outline of ECLIPSE · i-audio «E5503CDi»

**Common Parts**

- Outer Dimensions: 2DIN ( W178 x H100 x D155mm )
- Weight: 2.2kg
- On-board Deck: CD Deck/Memory Stick Slot
- Control Method: Main Unit Control ( Front panel operation )

**Display**

- 3.3-inch Color TFT LCD
- Screen Size: H56.16 x V61.42mm
- Resolution: 84,480 ( H160 x RGB x V176 )

- Wallpaper Display: Default 2 images, 1 Customizable image
- Background animation: Default 3 Patterns

**AV Parts**

- Radio ( AM/FM )
- Station Name Display
- CD ( CD-R/RW Compatible )
- MP3 Playback
- Memory Stick Audio Playback
- Digital Recording of Music from CDDA to Memory Stick (ATRAC3 Encoding)

**Telecommunications Parts**

- Hand-free Telephone
- Area SHOT
- E-iSERV ( ECLIPSE Portal Site ) Connectivity

## 3

**Main Characteristics**

The main characteristics of this unit's design and feature specifications are explained in this section.

**3.1 Design Overview**

The main focus of design development was how to attractively convey the functionality and features of the product to consumers. The design concept was developed after the aspects that needed to be emphasized for were conceptualized through novelty, anticipation and through images and assumed situations for actual use of the products.

The aspects of this unit that were emphasized in design development are listed and explained in this section.

**3.1.1 Molding, Layout****1) Consideration of Necessary Layout and Control**

Audio system products require that certain elements, such as the CD slot and the liquid crystal display, be located on the face panel. The above must be factored in when considering design as a whole. Structural elements such as a Memory Stick Slot to accommodate Memory Sticks containing image and music data and a keypad needed to meet control specifications were incorporated into the design of this unit. As a result, the con-

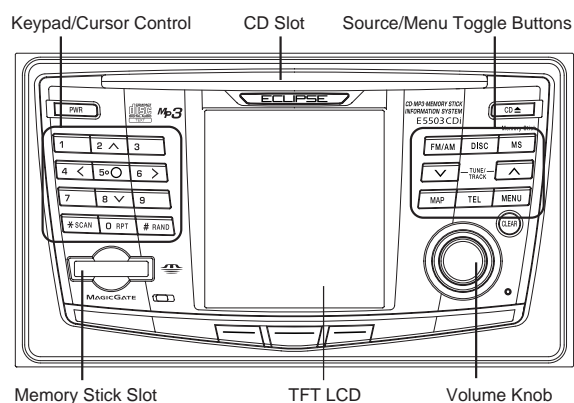


Fig.1 Visual Design Layout

nection between features and control was considered from the initial stages of design onward.

First, the unit is equipped with telecommunications features. The TFT LCD, which is the "window of information", is located in the center of the unit. This is the result of consideration made in regard to both expression of the units' functionality and visibility of the unit to the passengers of the vehicle in which it is installed.

Next, frequently used knobs and the source menu toggle button were placed on the right-hand-side of the face panel in a layout that emphasizes functionality for the driver (driver's side seat). In order to divide the unit's face panel into clearly defined areas for each type of use, the unit's characteristic keypad and Memory Stick slot were placed on the left-hand-side of the face panel. (Refer to Figure 1.)

There was a copious amount of structural elements that had to be included in this unit. For this reason, as well as concerns over button size, functionality, etc., the directional buttons that move the cursor (used alternately with the keypad) were combined with the keypad. In order to make the buttons easy to distinguish from one another at nighttime, the lighting color changes to amber when the cursor buttons are pressed. This was done because it would be difficult to distinguish the buttons from one another in the dark using only the labels printed on them.

## 2) Visual Design Conveying Advancement and Smartness

As represented by its telecommunications features, this unit is the pioneer of a new category. Accordingly, the first impression we would like the visual aspects of our design to convey is "advanced" and "smart". The desire to increase the status of this product is exemplified by its dynamic fusion of marketability and design.

In order to effectively convey the aforementioned design concepts, high gloss piano black paint was used on the unit's face panel in addition to hairline-accented acrylic panels and decorative parts detailed with lustrous silver metallic paint, accentuating the contrast of the unit's design. The balanced combination of finish and texture give the unit a more refined overall look and emphasize its advancement and smartness.

### 3.1.2 Screen Design

#### 1) Display Design That Emphasizes Consistency and Intuitiveness

This unit displays a wide variety of information onscreen, ranging from audio CD/radio station information, maps and other content downloaded from E-iSERV, to various settings.

In order to make this unit easy to use, it was necessary to employ ingenuity to create a design incorporating an environment that affords both controllability and familiarity. When formulating the basic layout, display content of a high degree of importance was verified. As

a result, a set of consistent rules regarding the prioritization of information to be displayed onscreen were established. Under these rules, title/menu information is continuously displayed onscreen in addition to information related to basic features such as the Easy Direction Display and electric field information.

Accordingly, even if the information displayed onscreen is toggled, there is an element of consistency maintained, and the position of information does not change, which reassures users and promotes understanding of the unit as a whole.

Characters of identical content are divided by group and displayed in a uniform tone/size. These divisions are applied throughout the system, which increases the cohesion of the unit as a whole. (Refer to Figure 2.)

This unit is equipped with a 3.3-inch TFT LCD display element capable of displaying 65, 536 colors blended together in a smooth gradient. Although the display is basically rendered in a graduated monotone in keeping with its visual design concept, data of vital importance such as information displayed via alphanumeric characters and icons is displayed onscreen in combinations of contrasting colors to make it easy to see. In order to fully utilize the unit's visual potential, realistic moving images that make full use of its color palette are used. (Refer to Figure 3.)



Fig.2 Basic Screen/Display



Fig.3 Background Animation/Display

## 3.2 Feature Outline

### 3.2.1 Control Methods

#### 1) Keypad Use

In order to simplify the use of multiple functions, a number was assigned to each menu item so that each item can be directly selected by pressing corresponding keys on the keypad. This ensures easy control of functions, which is similar to using a touch panel.

For character input, "the kana method", which is well-known because of the spread of cellular phones has been employed for increased controllability. (Refer to Figures 4-6.)



Fig.4 Keypad Control

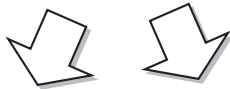


Fig.5 Menu Screen

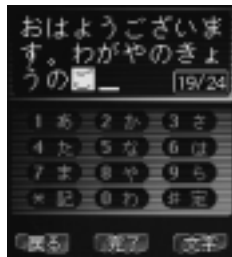


Fig.6 Character Input Screen

## 2) Use of 3-Function Buttons

The use of 3-Function buttons, which are located next to the screen in order to be distinguished from other buttons, has improved the controllability of important features. (Refer to Figure 7.)



Fig.7 3-Function Button Control

### 3.2.2 Newly-added Features

#### 1) Memory Stick capability

In keeping with the concept of next-generation audio, the card media predicted to be popular in the future was adopted as an audio medium.

Playback of music (ATRAC3 music files) stored on Memory Stick is possible.

Music can be recorded from CD to Memory Stick.

(Bit Rate: 132,105,66kbps, other features can be used during recording.)

Images stored on Memory Sticks can be uploaded to the unit and set/displayed as wallpaper.

#### 2) Direct Track Selection ( CD, CD-R/RW, Memory Stick )

A song can be directly selected with the keypad by inputting the number of the song you want to hear.

( Refer to Figure 8. )

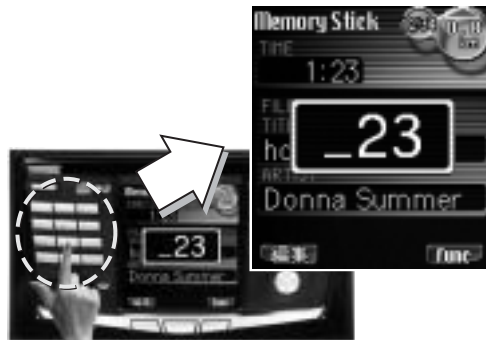


Fig.8 Direct Tuning

## 3) Area SHOT

### Present Location Map Acquisition

Maps illustrating the area surrounding present location can be downloaded, in order to confirm your position even in areas with which you are not familiar. (Refer to Figure 9.)

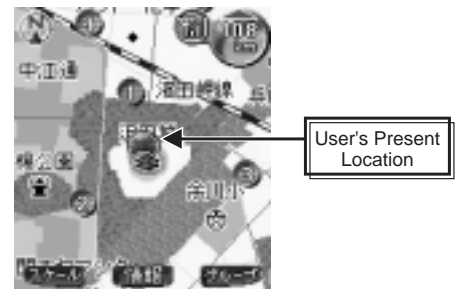


Fig.9 Present Location Map Display

### Designated Location Map Acquisition

Search for designated location via Telephone number (including private residence), Map Code, Zip Code or Train Station Name. Maps of the surrounding area can be downloaded, enabling location confirmation. Search location can also be set as a destination.

### Destination Setting

Spatial relationship between present location and destination can be confirmed by searching for designated location using Phone Number (including private residences), Map Code, Zip Code or Train Station Name and setting said location as a destination. This information can then be confirmed on the simple map. (Refer to Figure 10.)

It is also possible to toggle the display in order to view the direction/distance from destination, and to use



Fig.10 Overview Map Display

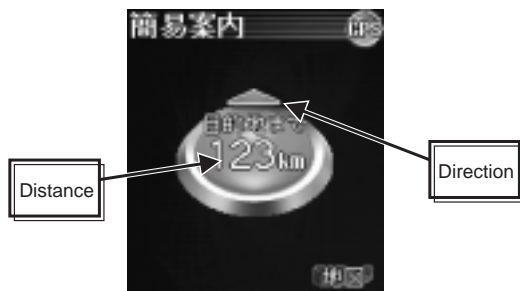


Fig.11 Simple Direction Guidance

Location, Registration Date, Information Provider Name, Comments, etc.



Fig.12 Group Information Display

this information as simple directions. (Refer to Figure 11.)

**Surrounding Area Information Display**

Each item of information can be displayed on the downloaded maps (Present Location Map/Designated Location Map), enabling confirmation within the surrounding area.

**-1 Surrounding Area Facility Information**

Location of gas stations, convenience stores, etc.  
Location, facility name, etc.

**-2 Public Information**

This is data for entertainment purposes that is set by individual users and made available to everyone on the network.

Location, Registration Date, Information Provider Name, Comments, etc.

**-3 Group Data ( Refer to Figure 12. )**

Data shared only among designated group members (password protected).

**4) E-iSERV Connection**

Unit is equipped with a browser dedicated for E-iSERV portal connection, enabling the acquisition of data (contents) from the portal site. This unit's default administrative services include: Destination Setting via Contents, Wallpaper for Download, and Fixed Form Sentences for Download. (Refer to the draft of "E-iSERV Architecture" for details.)

**4 System Architecture**

This unit is equipped with the following audio features: AM/FM radio, CD (CD-R/RW) player, and a Memory Stick slot. In addition to being able to listen to radio and play audio files with the aforementioned features, digital recordings can be made from CD to the Memory Stick. MP3 playback is possible through soft-

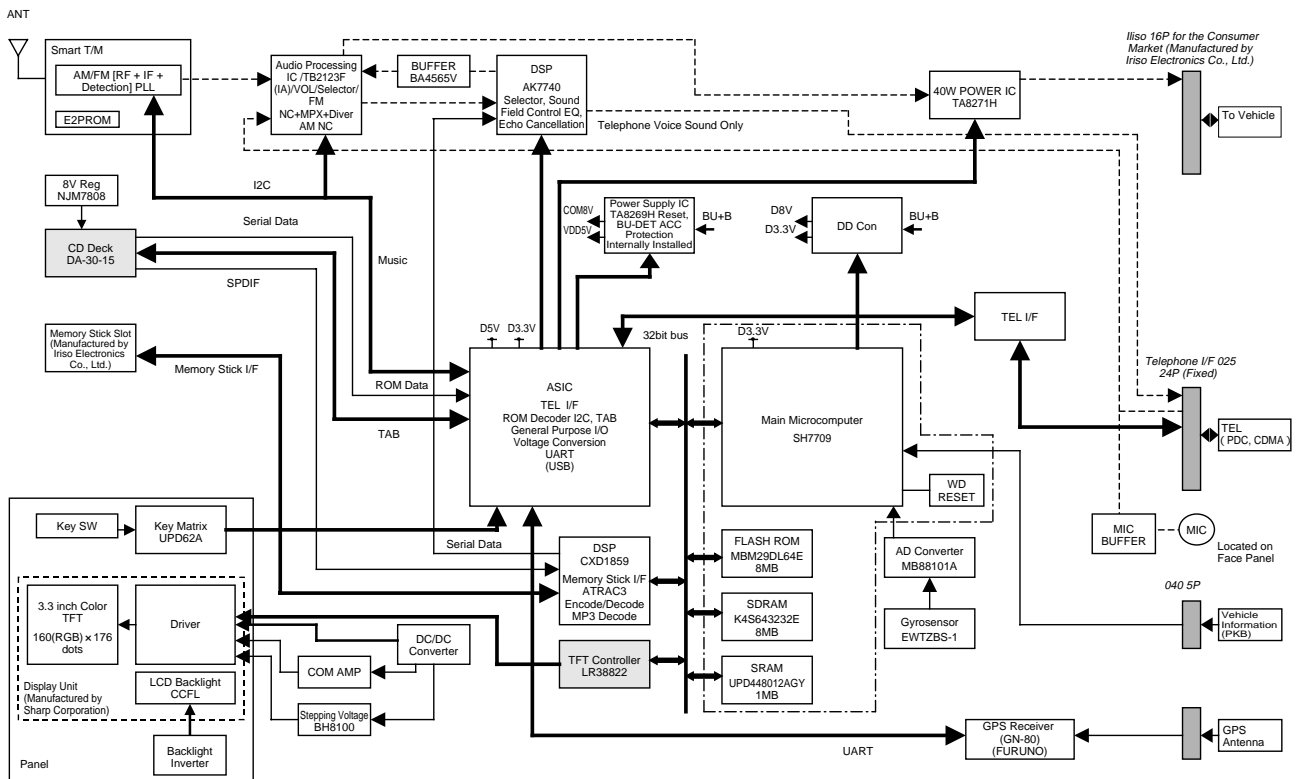


Fig.13 i-audio System Block Diagram



ware decoding. For the audio DSP in this unit, AK7740 with a 24 bit stereo ADC and a 24 bit, 4 channel DAC is employed.

Cellular phone connection I/F, ASIC and DSP are employed in order to enable hands free operation and use of telecommunications features such as connection to Area SHOT and E-iSERV. New in this model-a 3.3 inch color TFT LCD screen is used to display data not displayed in conventional audio-only devices, such as that obtained from Area SHOT and E-iSERV.

With respect to Area SHOT features, a GPS receiver, gyro sensor, and vehicle speed pulse are utilized in order to accurately determine vehicle position.

In order to reduce costs, hands free echo cancellation is done with DSP firmware instead of dedicated ICs. (Refer to Figure 13.)

## 5 Hardware Development

The parts and techniques used in the development of this unit are explained in this section.

### 5.1 3.3 inch Color TFT LCD Use

A 3.3 inch TFT liquid crystal module was used in this unit in consideration of the following two points: 1. That the display screen used would fit snugly into the 2DIN size face panel, 2. That data sent from Area SHOT and E-iSERV (ECLIPSE portal site), as well as song names, radio station ID, and audio mode screens such as DSP/EQUALIZER setting control are displayed in a format that is easily understood visually. The aforementioned improved the functionality of this audio set as an information terminal. ( Refer to Figure 14. )



Fig.14 3.3-inch TFT Liquid Crystal Module

#### 1) Specifications

- Screen Size ( diagonal ) : 8.3cm ( 3.3 inches )
- Effective Display Size: H56.16 x V61.42mm
- Resolution: 84,480 pixels ( H160 x RGB x V176 )
- Resolution Pitch: H0.117 x V0.349mm
- Pixel Alignment: R,G,B Vertical Columns
- Outer Dimensions: W73.4 x H73.4 x D10.2mm

#### 2) Main Characteristics

- Transparent active matrix liquid crystal display that uses an amorphous silicon thin film transistor (TFT).
- 18 bit (6 bit x RGB) digital data signal enables 262,144 color display.
- Outside light glare is reduced by the use of a low reflective black matrix and an AG (anti-glare) polarizing plate.
- Thin shape, lightweight and compact module form achieved through the utilization of COG mounting techniques.
- Built-in backlight that responds well in low-temperature environments.

This unit produces clear images by digitally controlling all image signals including Area SHOT and E-iSERV (ECLIPSE portal site) screens. The 3.3 inch TFT display control block is shown in Figure 15. (Refer to Figure 15.)

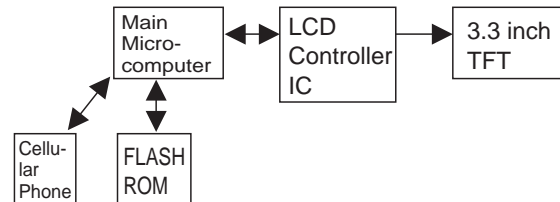


Fig.15 3.3-inch TFT Display Control Block Diagram

In the main microcomputer, bit map data stored in flash ROM and data received through cellular phones such as wallpaper and maps is read and sent to the LCD controller IC connected via the 16 bit bus.

The LCD controller IC controls the display of the 3.3 inch TFT by converting the data transmitted from the main microcomputer into 18 bit (6 bit x RGB) digital image signals, which are the interface for the 3.3 inch TFT module, and outputting these signals in synchronization with the TFT timing signal (including clock pulses and start pulses from the gate driver and the source driver).

#### 5.2 GPS Receiver Use

A GPS receiver is installed in this unit to enable the vehicle's position to be determined in Area SHOT, one of this product's most important features.

GPS receivers were used for the first time in this

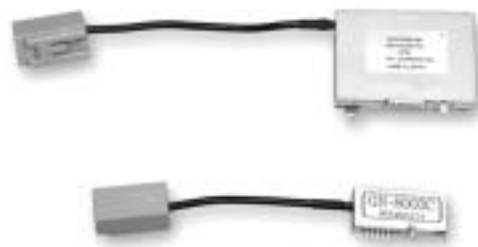


Fig.16 GPS Receiver (Above : Previous Product(s), Below : Product described herein)

product in order to further miniaturize the unit (approximately 1/3 the size of the previous unit) and lower costs (12% reduction). (Refer to Figure 16.)

### 1) Specifications

- Reception Signal: L1(1575.42MHz), C/A Code
- Positioning Method: SPS Individual Positioning  
DGPS Positioning
- Maximum Number of Tracking Satellites: 12
- Position Update Frequency: Once per second
- External Serial Transmission: Asynchronous Serial
- External Serial Transmission Speed: 4800bps
- Output Data Format: NMEA
- High Speed TTFF (Uses search engine to increase speed of satellite acquisition)
  - : Hot start 9 seconds (50% reduction in comparison with previous model)
  - Warm start 36 seconds (20% reduction in comparison with previous model)
  - Cold start 43 seconds (75% reduction in comparison with previous model)
- Positioning Accuracy:
  - Horizontal Accuracy (2drms) 10.5m (Experiment Data)
  - Vertical Accuracy (2 ) 12.5m (Experiment Data)
- Miniaturization/Cost Reduction
  - : Chip-mounted IF filter
  - Correlation Device converted to 16ch
  - High Speed Search Engine Added
  - WAAS-compatible correlation device architecture
- Current Consumption 72mA (50% reduction in comparison with the previous model)

### 5.3 Memory Stick Slot Use

This unit is Memory Stick-compatible. The optimal Memory Stick Slot was selected through consideration of the following:

#### • Memory Stick Insertion/Removal Capabilities

When Inserted: Stick locks into place; feels firmly inserted

Insertion strength: 10N or less

When Removed: Adequate length of the stick is ejected for easy removal

Length of ejected part: 12mm

\* Ejected part length of 15.6mm from the product panel, optimal control feel achieved.



Fig.17 Memory Stick Slot

#### • Memory Stick Slot Attachment

Simple to install to product; connection to circuit board made easier through use of flexible cable.

#### • Vehicular Compatibility

Satisfies reliability tests.

Example) Durability: After 20,000 insertions/removals, electric capabilities and eject mechanism still function.

### 5.4 CAE Analysis/CADR

In addition to 3-D design, design development of this unit was promoted with CAE analysis/CADR modeling.

One of the reasons that CAE analysis/CADR are used is to secure initial design quality. Specifically, CAE analysis/CADR are implemented to make simulation easier, enabling evaluation without the need for prototypes. By employing this approach, reliable evaluation results are obtained at the development stage, eliminating repetition of cut-and-try procedure that is traditionally performed. Now, simulations can be performed as many times as necessary by just inputting the data. Increasing the accuracy of analyses helps cut development costs and shorten the development period because evaluations of molded products, etc. can be obtained without a prototype.

#### 1) CAE Analysis is carried out on the following:

##### • Flow Analysis

Correct gate position is determined through analysis of camber/weld lines.

##### • Illumination Analysis

Analysis that determines whether or not brightness is consistent for all character widths enables optimization of light emitting elements, distance, etc.

##### • Button Feeling Analysis

Total feel is estimated using buttons design elements as applied to switch load. Fulcrum, distance, etc. are optimized.

##### • Strength Analysis

Comparative analysis performed to determine whether or not any sections of the unit are weaker than the same section in the previous model.

##### • Allowance Analysis

Contribution rate of size allowance and geometric allowance of each part can be used to get a rough idea of important control size.

##### • Thermal Hydraulic Analysis

Comparative analysis carried out to determine whether or not unit deals with heat better than its predecessor.

There is also an additional type of analysis called instrument panel shock analysis. Since instrument panel shock analysis is intended to be introduced at a later date, it is not part of the system described herein. As examples of various analyses, temperature distribution and air flow at each part of the product are shown in Figure 18. (Refer to Figure 18.)

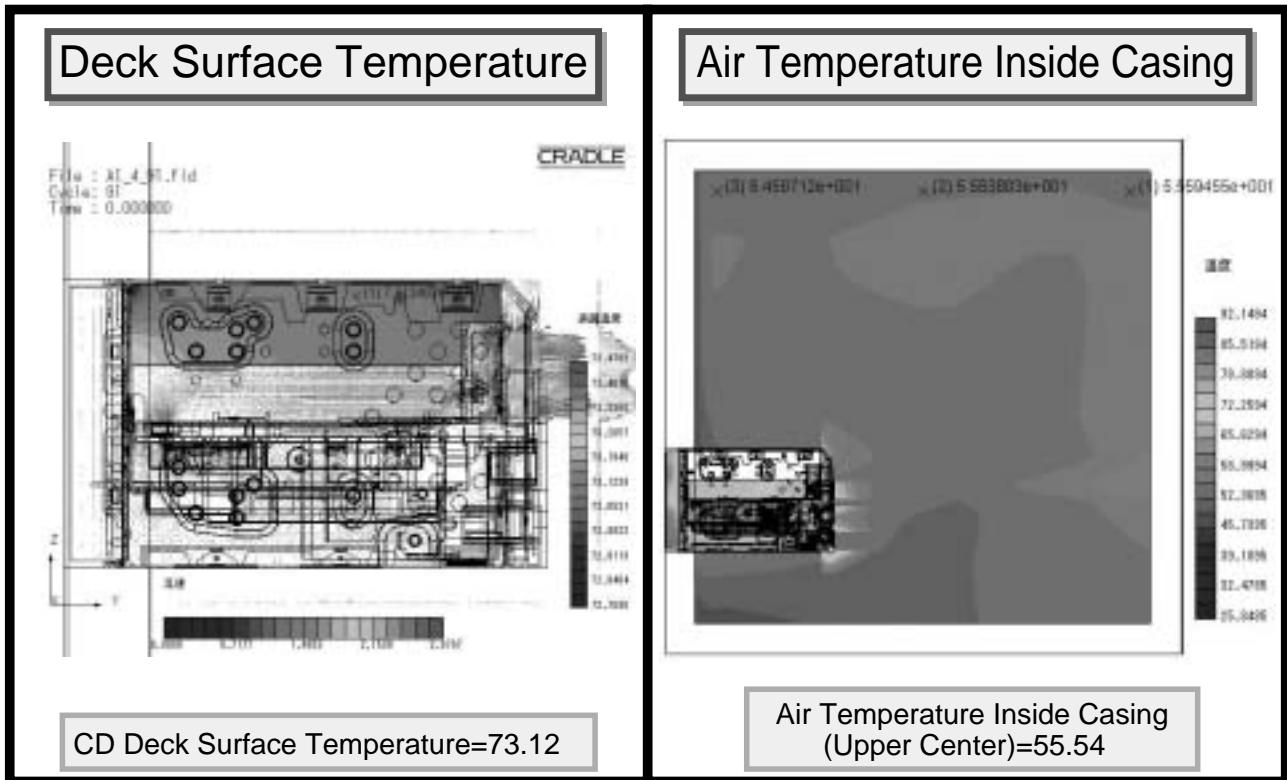


Fig.18 Thermohydrodynamic Analysis (Temperature distribution across each part of the product, airflow)

2) CADR Items

• DR (Design Review)/PR (Production Review)

Three-dimensional pictures of 3D models can be used to gain an understanding of unit structure. By doing so personnel in manufacturing and related departments can work with designers to advance problem-solving strategies.

• Usability/Visibility Simulations

Simulations are conducted on the effects of usability (button control) and visibility (viewable angle). (Refer to Figure 19.)

• Interference Check

In order to prevent faults in movement and short circuits from occurring, the clearance between individual parts is checked.

3) CAE Analysis/CADR Successful Results

Successful results attributable to CAE analysis/CADR in the development of this unit are given below:

- Weak points were located in the design stage and applied to drawings in order to correct molds at an early stage. Sampling defects found: 13 (Refer to Table 1)
- Simulation use cut down on the number of man hours, increasing efficiency.
- Correlation of prototype evaluation results, increased effectiveness for CAE analysis/CADR in subsequent design development confirmed (possible without prototypes).

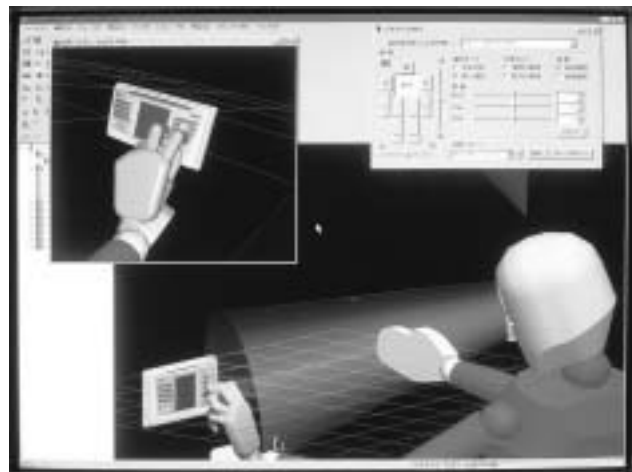


Fig.19 Operation/Visibility Simulation(s)



Table 1 CAE Analysis / Extraction of Nonconformity Contents/Number of Incidents via CADR

Item	Determination	Details	Number of Faults
Flow Analysis	x	Although the top of the CD slot on the body panel may warp severely, this can be dealt with by strengthening it (front panel).	1
Lighting Analysis	x	Ceiling wall thickness low; within level that can be dealt with by adjusting electric current value.	1
Button Feel Analysis		Feel analysis OK. Correlation with actual unit OK.	0
Strength Analysis		Button motion checked. Up/Down motion OK. Button motion in actual unit also OK.	0
Allowance Analysis	x	Sections with a large allowance found in Memory Stick and panel; dealt with.	1
Thermal Hydraulic Analysis		Fan effectiveness checked.	0
CADR, PR		Requests from Manufacturing Department due to CADR implementation anticipated.	5
Controllability/Visibility Simulation	x	Visible angle inadequate. Acrylic panel form changed.	2
Interference Check	x	Internal interference detected; dealt with.	3

## 6 Software Development

New techniques used in the development of software for this unit are introduced here.

### 6.1 Area SHOT Development

Area SHOT features are enabled by requesting data from this unit to the server and receiving those responses. (Refer to Figure 20.)

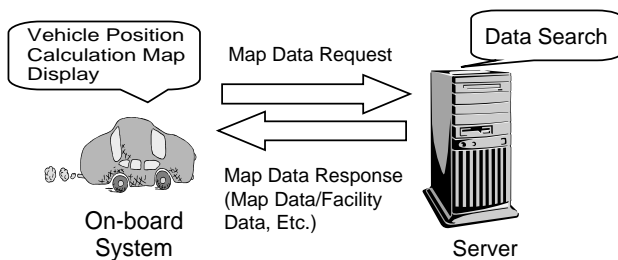


Fig.20 Area SHOT System Diagram

As a way of implementing features, the unit was equipped with a browser that displays Area SHOT and E-iSERV portal screens.

The use of a browser identical to those that have performed well in the IT Cluster, Fujitsu TEN, Ltd.'s first-developed Car Infotainment product (equipped with telecommunications features for Daihatsu Motors Co., Ltd. vehicles), was considered. However, since this unit has a lower price point than that of the IT Cluster, and also because audio, Area SHOT, E-iSERV portal display, and hands free features are all on a single chip, it was determined that the aforementioned browser was inappropriate from the standpoints of cost and memory size. For this reason, a dedicated i-audio browser that only performs the functions necessary for this unit was developed.

#### 1) i-audio Dedicated Browser Features

In order to satisfy cost/memory size requirements, necessary features were determined. (Refer to Table 2.) The main point kept in mind when determining what

features were necessary was that while most browsers such as Internet Explorer, Netscape, etc. are designed to access all sites, the access for the browser in this unit would be limited to a specified (E-iSERV) site.

Table 2 Simple Browser Functions

Item	Support Details	
E-iSERV Connection	HTTP	1.0
	Kanji Code Description	ShiftJIS
	Method	GET, POST
	History Lists	Can only see previous list
	HTML	Supported Tag Restriction (only E-iSERV)
	Supported Formats	http, file:
	Supported Image Types	JPEG, PNG, BMP
Area SHOT	Plug-in I/F	Dedicated to Position Information Applications
		Position Information Application I/F Screen Switching Management

#### 2) i-audio Dedicated Browser Structure

Next, a browser structure that would enable these features was determined. (Refer to Figure 21.) A vehicle position control block indicated in the architecture dia-

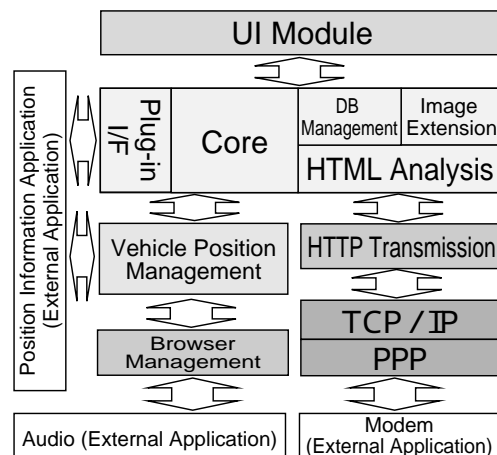


Fig.21 i-audio Browser Architecture Diagram

gram is the block where user operations for and display changes of Area SHOT are controlled.

**3) i-audio Dedicated Browser Characteristics**

A list of i-audio dedicated browser characteristics is provided here.

**Increased Controllability**

On the Area SHOT screen, the browser is required to function seamlessly so that users are remained unconscious of the fact that they are actually operating the browser. Therefore, radio button commands different from those used during portal display were added. "Select" and "Enter" actions are necessary for radio buttons during portal display. (Refer to Figure 22.) While during Area SHOT display, the "select" and "enter" actions can be implemented simultaneously. (Refer to Figure 23.)

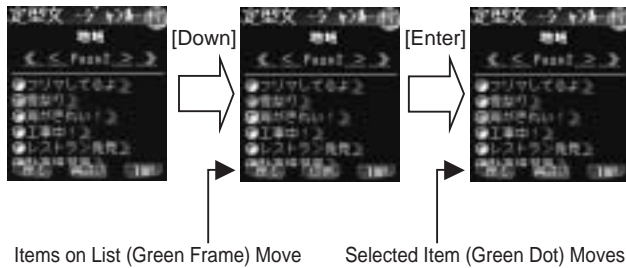


Fig.22 Radio Button Operation During Portal Display

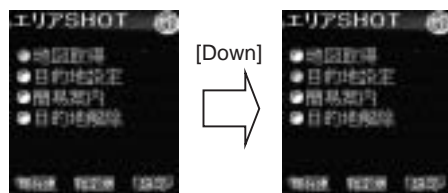


Fig.23 Radio Button Operation During Area SHOT Display

**Individual Tags**

Individual tags (attributes) are set and supported in order to support operations specific to on-board systems, improve drawing speed (frame rate), and prevent flickering. (Refer to Table 3.)

Table 3 E-iServe Original Tag

Tag (Attribute) Name	Function
tonedown=" pkb "	Turns tone down in response to PKB.
tonedown=" fixed "	Turns tone down at designated time.
bgnoclear	Continues background from previous HTML screen.
penddraw	Does not update HTML until background is completely drawn.

**Cost Reduction/Memory Savings**

Even though Area SHOT dedicated support was implemented, this browser could be made at a lower cost and with less memory than the browser on board the IT Cluster since compatible tags were selected and only necessary features were included. (Refer to Table 4.)

Table 4 Cost/Memory Capacity Comparison

	Running Cost	Memory Size (ROM)
Standard Browser	1,105 yen/per unit	2,000KB
Simple Browser	0 yen/ per unit	390KB

**6.2 Memory Stick Driving Recorder Inclusion**

A "driving recorder" is a feature that records memory stored values, program execution status, and internal transmission history in order to detect faults and potential problems early and perform analysis. Although the installation of a "driving recorder" in this unit was considered, it was abandoned because the large amount of memory required for programs that control features and the cost of parts mean that there is not much empty RAM in the unit. In order to reliably secure enough memory for the "driving recorder" and to increase the efficiency of data collection during the occurrence of a fault, data is recorded on Memory Sticks in a binary format. A maximum of 256MB (Memory Sticks with a memory select feature) of data can be saved, data collection efficiency during error occurrence increased, and contributions were made to early quality assurance. (Refer to Figure 24.)

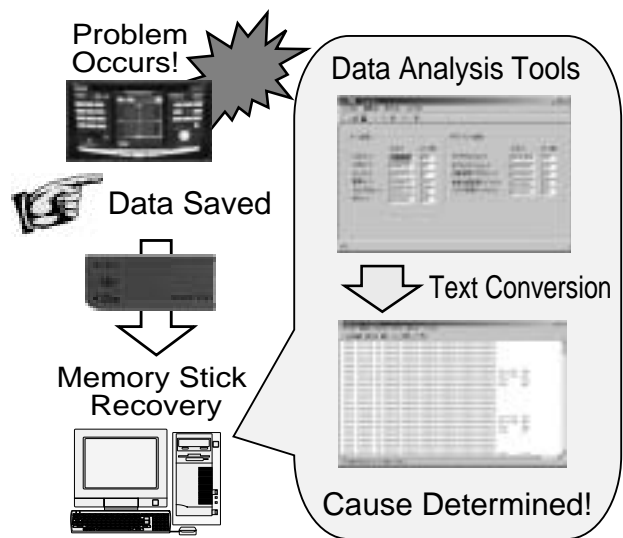


Fig.24 Driving Recorder via Memory Stick

## 7

**In Closing**

This unit is the first model of on-board terminal that is compatible with E-iSERV, Fujitsu Ten, Ltd.'s dedicated server. Amidst an environment in which every manufacturer is putting expensive, high-performance telecommunications terminals on the market, expectations are high that this unit, which is positioned as part of Fujitsu Ten's audio product line, will pioneer a new market for vehicular telecommunications terminals, becoming a leading, top-rated next generation audio product.

Basic information transmission techniques were established throughout the development of this unit. In the future, Fujitsu Ten plans to turn its attention to the development of features such as multipurpose browsers, transmitted audio, and navigation systems pursuant to breakthroughs in the telecommunication services field of the automotive market in addition to improving the services offered through E-iSERV.

The product names and proper names listed below are trademarks or registered trademarks of their respective companies.

**Registered Trademarks**

- G - BOOK Toyota Motor Corporation

**Trademarks**

- **audio** FUJITSU TEN LIMITED
- CARWINGS Nissan Motor Co., Ltd.
- Internavi Premier Club Honda Motor Co., Ltd.
- Air Navi Pioneer Corporation
- YOU Navi Matsushita Electric Industrial Co., Ltd.
- CADIAS Clarion Co., Ltd
- Memory Stick Sony Corporation

**Profiles of Writers****Koichi Matsuda**

Entered the company in 2000. Since then, has been involved in the product planning of visual products and car audio. Currently in the System Planning Department of Engineering Division 1, Business Division Group.

**Syoji Ueoka**

Entered the company in 1992. Since then, has been involved in the product planning of visual products and car audio. Currently in the System Planning Department of Engineering Division 1, Business Division Group.

**Isao Hamada**

Entered the company in 1990. Since then, has been involved in software development for car audio, displays, and car infotainment products. Currently in the Software Engineering Department of Engineering Division 1, Business Division Group.

**Satoru Nakae**

Entered the company in 1997. Since then, has been involved in the development of software for car infotainment equipment and car navigation systems. Currently in the Software Engineering Department of Engineering Division 1, Business Division Group.

**Shigeo Nakamura**

Entered the company in 1997. Since then, has been involved in car audio product design development. Currently in the Products Planning Department of Engineering Division 2, Business Division Group.

**Tatsuo Fujii**

Entered the company in 1991. Since then, has been involved in car audio circuit design. Currently in the Engineering Department of Engineering Division 1, Business Division Group.

**Takeshi Watanabe**

Entered the company in 1994. Since then, has been involved in car audio circuit design and display systems. Currently in the Engineering Department of Engineering Division 1, Business Division Group.

**Yoshinori Kagaya**

Entered the company in 1983. Since then, has been involved in structural design of car audio. Currently in the Mechanical Engineering Department of Engineering Division 2, Business Division Group.

**Shigehiko Miura**

Entered the company in 1987. Since then, has been involved in car audio-visual product software development. Currently the Manager of the Software Engineering Department of Engineering Division 1, Business Division Group.