NOTE

Development Support Systems

Masatsugu KAMIMURA
Philip TENORIO

1 Introduction

Fujitsu Ten Solutions Philippines, Inc. (hereinafter, referred to as FTSP) was established in 1999 as the first offshore design company in Fujitsu Ten group, having split off from "Software Business Project Department" under Fujitsu Ten Corporation of the Philippines. From its establishment, Car Infotainment Department (hereinafter, referred to as CID), in charge of developing software for audio devices, has developed development support tools for Fujitsu Ten Limited (hereinafter, referred to as FTL). For the first few years, CID has developed relatively simple tools, which includes simulators and file generators. Afterwards, CID has expanded its development field in accordance with diversification of the demand toward software for supporting development processes and tools for management of problems.

Fig. 1.1 illustrates the types of solution tools that can be provided by the CID.

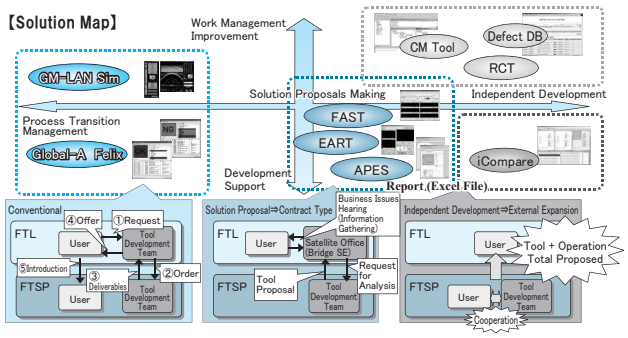

Fig.1.1 Tool Solution map

By fully utilizing the merits of having both hardware engineers and software engineers, FTSP has developed tools for supporting development of the audio products, like "Automatic Product Evaluation System" (hereinafter, referred to as APES), and a "drawing comparison tool (hereinafter, referred to as iCompare)" since FTSP launched in-house joint projects in 2008.

This paper describes the basic technology and concept applied in the development of the APES and the iCompare, and introduces our efforts for the future.

2 APES and iCompare

2.1 APES

APES, a system designed for automatically measuring electrical characteristics of audio products, is used in a design verification process wherein a designer confirms whether the product design conforms to the specifications.

During the design process, a designer has to spend several hours making measurements, analyses and evaluation of an audio product, and also has to manually make adjustments to a prototype and instruments so as to measure the characteristics of the audio product. The APES provides automatic settings and measurements for all these processes. After making necessary initial settings, the designer can leave the system for measurements and focus entirely on high value-added works such as result analyses and other designing tasks.

The APES is composed of instruments (audio analyzer, signal generator) controlled by use of the GPIB (General Purpose Interface Bus), a communication box for communication with the product and a personal computer for controlling the communication box. **Fig. 2.1** illustrates the system configuration of the APES.

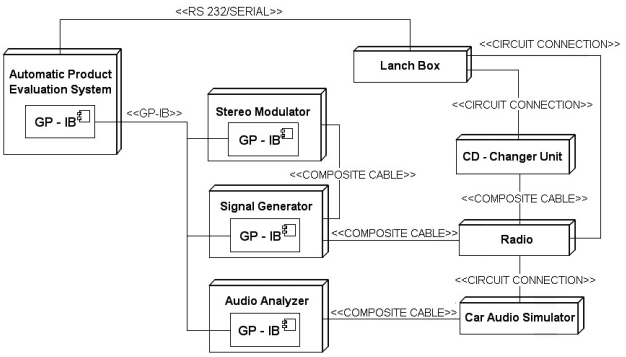

Fig.2.1 APES system configuration

2.2 iCompare

The Mechanical Design Section of the Hardware Design Department (hereinafter, referred to as HDD), in charge of audio product hardware design, receives projects for designing front panels of audio products. The members of the section are tasked to check that a change point conforms to the design intent by comparing a drawing to its previous version, and to report the results to the design consignment origin. By the former design method, where these processes are visually and manually done, the quality level and the design procedure are largely dependent on the skills and the past experiences of the designer and the reviewer.

The iCompare was developed in order to automate and speed up the comparison process between the change points, before and after the change, and to obtain accurate results independent from the skills and the past experiences of the designer and the reviewer.

This tool detects a change point by comparing the pixel values of the new drawing image against the previous one. The tool also provides comparison results in a pre-defined in-house format.

3 Function

3.1 Major Function of APES

The APES provides two major functions: (1) setting of prototype for evaluation; and (2) automatic measurement and generation of curve data results.

As shown in Fig. 2.1, the APES automatically controls the target car audio product and measuring instruments (audio analyzer and signal generator), and measures the characteristics of the target product.

The car audio product is connected through a communication box by use of LAN protocol and is controlled by dedicated commands. The measuring instruments are controlled by use of the GPIB protocol. **Fig. 3.1** shows the setting screens for the individual instruments.

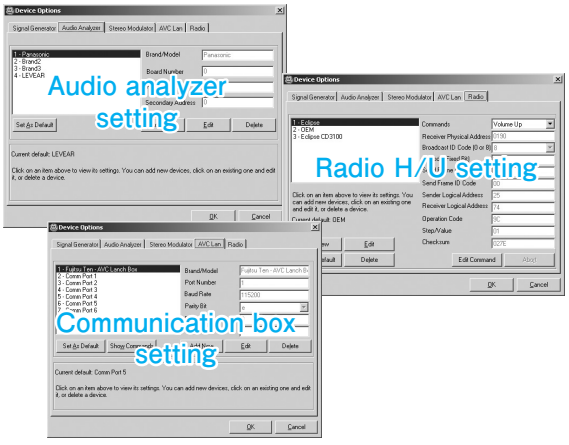

Fig.3.1 Setting screens of instruments

The APES allows for real-time measurements of curve data for the following: AM, FM, loudness, treble, bass, balance, fader and volume. The AM curves provide useful data for the measurement of Small Signal-to-Noise (S-S/N), Large Signal-to-Noise (L-S/N) and Carrier-to-Noise (C/N) ratios. The FM curves provide useful data for the measurement of channel separation in addition to the same three measurements as the AM curves.

Fig. 3.2 illustrates sample measurement curves generated by the tool.

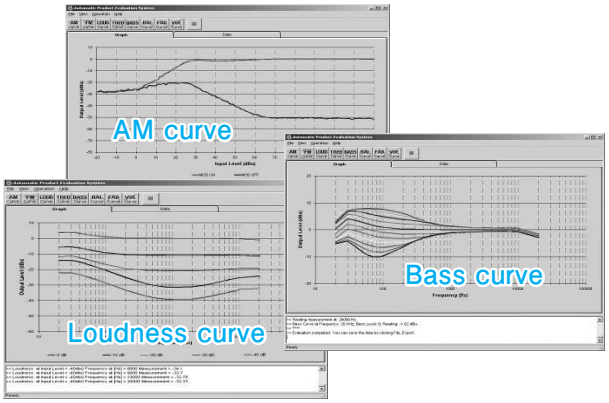

Fig.3.2 Sample measurement curves

3.2 Major Function of iCompare

The iCompare outputs a comparison result showing differences between two images. **Fig. 3.3** shows the main GUI screen. The image-before-change is displayed on the left of the screen, the image-after-change is on the center, and the comparison result is on the right with the differences indicated by red-colored marks.

The designer, as a user, judges if the design changes are properly reflected through the comparison result. Since the tool allows the designer to assign tags on the comparison result, the generated drawing can be used as a review result (**Fig. 3.4**).

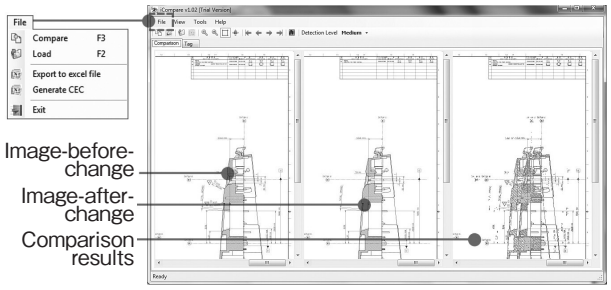

Fig.3.3 iCompare main GUI screen

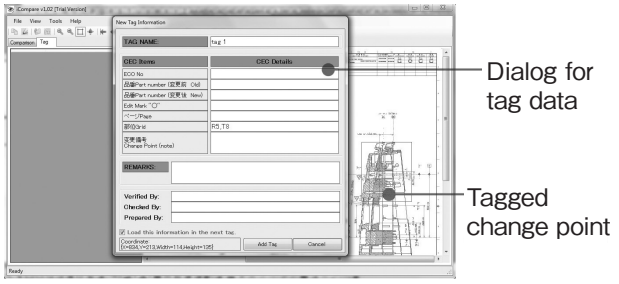

Fig.3.4 Setting screen for drawing output of comparison result

4 Key Technology

4.1 Measurement Procedure by APES

As described above, the APES automates the evaluation of car radio characteristics. We have achieved effective measurements by incorporating in the program the method in setting measuring instruments and the measurement procedure that would obtain stable results, which originally came from designers in the headquarters.

Connected external devices (signal generator, audio analyzer and stereo modulator) are controlled by the use of the Agilent IO Libraries Suite. The Agilent IO Libraries Suite is a collection of open source libraries that are used for controlling external communication devices, and enables the connection to various devices through interfaces like the GPIB.

After establishing connection to the external devices, the APES transmits a control command to the devices through the GPIB interface. The response of each device to the command transmitted by the APES is indicated by a change in the display screen of the instrument. **Fig. 4.1** illustrates a sample sequence to change signal generator frequency, and **Fig. 4.2** illustrates a sample sequence for reading signal generator settings.

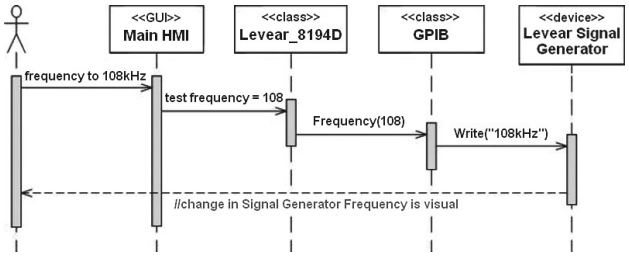

Fig.4.1 Changing signal generator frequency

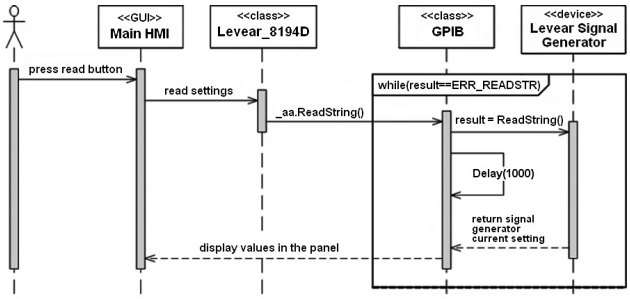

Fig.4.2 Sequence for reading signal generator settings

4.2 Rotation Function

Aside from the usual whole image comparison function, the iCompare also has a function for selected area comparison. This function is especially effective in the following three situations: (1) when change points only in a particular area of a drawing are extracted; (2) when an entire drawing or a part of the drawing is rotated; and (3) when a part of the drawing is located at a different position from the one in the other drawing. **Fig. 4.3** shows a sample result of partial comparison regarding two drawings (the parts in blue-colored boxes are compared).

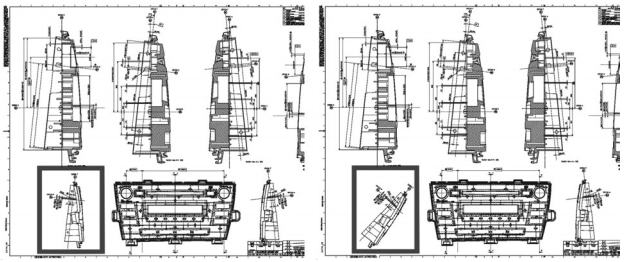

Fig.4.3 Sample comparison regarding rotated image in selected area

The iCompare has a function for correcting the angle of a rotated image or its selected part before comparison is done. The user selects the comparison area, calls Rotate menu, and specifies the angle of rotation (**Fig. 4.4**).

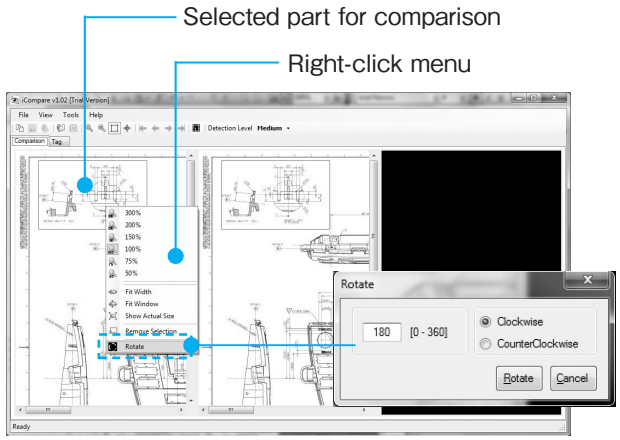

Fig.4.4 Rotation angle correction

The angle correction is done according to the following procedure:

Step 1 Load the image data of the selected area
Step 2 Specify the coordinates of the area (**Fig. 4.5**)
Step 3 Obtain the target angle of rotation
Step 4 Define a temporary area covering the four projected points after the image is rotated (**Fig. 4.6**)
Step 5 Calculate the area defined in the previous step based on the four projected points and target angle of rotation (**Fig. 4.6**).
Step 6 Convert the image through the Rotate function (**Fig. 4.7**)

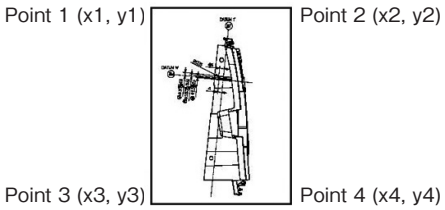

Fig.4.5 Original image and coordinates

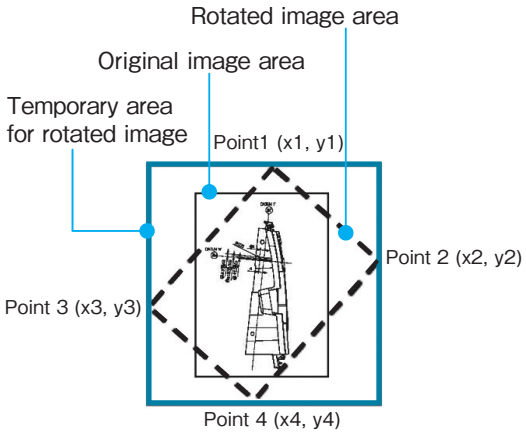

Fig.4.6 New coordinates after rotation

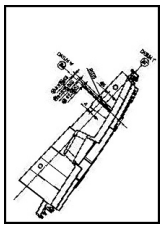

Fig.4.7 Rotated image

5 Benefits

The introduced tools contribute a great deal to improvement in the efficiency of development works. Moreover, it allows for an increase in knowledge and technical know-how. As a result, HDD design business can shift to a higher level and with additional value.

The APES contributes to reducing man-hours for evaluating radio performance in electric design down to 10% or less. The iCompare allows a designer to detect change points without any omission on a standard drawing and succeeds in reducing working hours by half.

6 Efforts for the future

We are continuously improving the performance and adding more functions to the APES and iCompare.

As for the APES, we have started to develop a succession system, called PROBE (PROduct Bug Evaluator), so as to fully automate the audio device design evaluation. In preparation for future various expansions in audio functions, the communication functions such as the GPIB and individual measurement functions shall be developed separately, and individual functions shall be implemented as plug-ins. We are preparing a prototype, which includes a function for controlling other external devices other than measuring instruments.

As for the iCompare, in addition to the current basic functions, we are planning to develop new functions including support of various image formats, support of scaling, and an automatic control of comparison tolerance.

We, at FTSP, will keep on making efforts to develop tools for supporting designers, which incorporates the latest technology.

Profiles of Writers

Masatsugu KAMIMURA

Entered the company in 1986. Since then, has engaged in the development of digital signal-processing algorithm for audio systems and millimeter-wave radars, and software for car navigation systems and car audio systems. Currently the Department Manager of Car Infotainment Department in FTSP.

Philip S. Tenorio

Entered FTCP in 1998. Moved to FTSP in 1999. Since then, has engaged in the software development for car audio development and evaluation support tools. Currently the Manager of the Tool Development Section of the Car Infotainment Department.