802.11a/g-Compatible Wireless Presentation System "AirProjector"

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The Network Department put on the market in February 2002 the AirProjector – a wireless presentation system that applies high-speed wireless LAN technology. Since the system was put on sale, it has steadily increased in industry recognition and sales volume. However, in order to meet the growing market needs for higher display speed, compatibility with higher resolution, higher PowerPoint animation speed, smaller system size, etc. and to differentiate our product from those of the competition, we have recently developed an upgraded version of AirProjector – an 802.11a/g-compatible wireless presentation system. This paper describes the functions and features of the new product.

Key Words: *802.11a/g-Compatible Wireless Presentation System "AirProjector", IEEE802.11b, IEEE802.11a, IEEE802.11g.*

1. Introduction

Formerly, for the purpose of presentations, the overhead projector (OHP) was most commonly used. Recently, however, the method of presentation in which an intelligent projector is connected directly to a personal computer to present data displayed on the personal computer monitor screen is rapidly becoming widespread. At present, an analog RGB interface is most widely used for connection between the projector and the personal computer. With this method, however, the positional relationship between the personal computer and the projector is limited by the length of the connection cable used. Besides, in many cases, it takes considerable time for a presenter to connect his own personal computer to the projector.

In order to solve the above problems, the Network Department developed a wireless presentation system, AirProjector KJ-100B, and put it on the market in February 2002. In developing the product, we applied high-speed wireless LAN technology compatible with IEEE802.11b, the wireless LAN standard that is most widely adopted in recent years, to allow for presentations using a wireless projector and permit more than one user to share the same projector.

Since the product was put on sale, it has steadily increased in industry recognition and sales volume.

Recently, in order to meet the growing market needs for higher display speed, compatibility with higher resolution, higher PowerPoint animation speed, smaller system size, etc. and to differentiate our product from those of the competition, we have come up with an upgraded version of AirProjector–an 802.11a/g-compatible wireless presentation system.

By meeting IEEE802.11a and IEEE802.11g, the new standards that specify a wider radio frequency range and a higher communication speed than does IEEE802.11b, we increased the wireless LAN communication speed, thereby speeding up the data display and PowerPoint animation. In addition, we could dramatically reduce the system size by completely changing the hardware configuration of the system.

2. Product outline

The wireless presentation system “AirProjector” is an image transfer & display system which receives images displayed on the personal computer monitor screen via a wireless LAN and puts them out via an RGB interface. The system uses the Windows software to obtain and transfer image data from the personal computer.

The conventional AirProjector, KJ-100B, has a number of features, including the applicability of any projector of any maker as long as it has RGB input terminals, the capability to transfer and display high-quality image data from the personal computer at a high speed, the one-shot transmission function that transfers only one screen of data at a time, the security compatible with the ESS ID/WEP 64/128 bit scheme, and the function that permits more than one user to switch between display screens.

The newly-developed, IEEE802.11a/g-compatible AirProjector has all the functions of KJ-100B. In addition, by meeting the new IEEE802.11a and IEEE802.11g standards, we increased the wireless LAN communication speed, thereby speeding up the data display and PowerPoint animation. Furthermore, the new system is much smaller in size than KJ-100B and compatible with higher resolutions. With respect to the Windows software for input and transfer of image data too, we increased the processing speed, simplified the settings for communications, made the display screen easier to operate on, and provided the multi-screen function that permits transmitting data from one personal computer to more than one projector simultaneously.

3. Development concepts

In launching development of the new product, we decided on product concepts to differentiate it from the conventional KJ-100B and similar products of the competition. They are described below.

- More and more projectors are being made compact in size and mobile. Therefore, the new product shall be exceptionally small in size.
- The new product shall be capable of higher-speed image processing and data transfer to allow for smoother presentations.
- In view of the spread of notebook-sized personal computers and home theaters which are compatible with high resolutions, the new product shall be made compatible with SXGA.
- The new product is intended not for ‘specialists’ (e.g., network administrators), but for general users. Therefore, it shall be made extremely easy to use, mainly through simplification of the settings for communications and the connection with a network.

4. Features and novelties of the product

4.1 Improvement on Windows software for input/transfer of images

The Windows software for input/transfer of images is a computer program which inputs image data on the monitor screen of a personal computer and transfers the image data to the network. Formerly, the software had a number of problems.

In developing the new product, we made the following improvements on the software to solve those problems.

4.1.1 Making the software easier to use

The conventional Windows software for input/transfer of images was rather difficult to use because of the complicated procedures for setting images to be input and transferring those images. Therefore, the procedures have been greatly simplified so that even users who are not well versed in personal computers can understand them easily (**Fig. 1**).

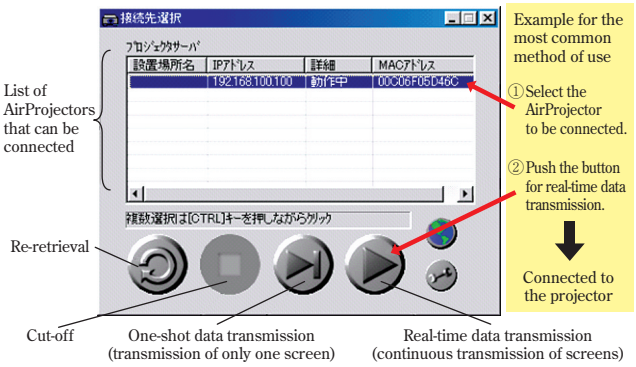

Fig. 1 Windows software for input and transfer of images

4.1.2 Simplifying the settings for TCP/IP and wireless communication

Formerly, when it comes to transferring images, it was difficult to make the necessary settings for communications with a personal computer. Therefore, the following improvements were carried out to simplify the settings.

4.1.2.1 Simplification of TCP/IP settings

When connection with the AirProjector is selected, the processing for the connection is performed even if the IP address system of the AirProjector is different from that of the personal computer.

4.1.2.2 Simplification of settings for wireless communication

Even if the settings for wireless communication with the user’s personal computer are different from those for the AirProjector, the settings of the wireless LAN card are temporarily changed to perform the processing for connection between them.

4.1.3 Speeding up input/transfer of images

Since a large volume of data is handled in the transfer of images, compressing the data places a heavy burden on the CPU. With the conventional Windows software for input/transfer of images, the processing speed of the application programs that are running on the personal computer declines markedly, especially when the CPU capacity is not very large or many application programs are in operation.

The above problem is ascribable to the fact that the conventional software occupies a fixed portion of the CPU of the personal computer for image input/transfer and that the software continually puts the CPU under load since as soon as an image is input and transferred, another image is input.

Therefore, the CPU load factor has been made variable so that the CPU occupancy rate of the software becomes optimum at all times. In addition, the timing of screen input has been reduced and a function which detects an event at the time of screen changes to determine the timing of screen input has been provided. As a result, the CPU occupancy rate of

the software has been decreased and the speed of image input/transfer has been increased.

4.1.4 Compatibility with multi-screen capability

Formerly, images could be transmitted from a personal computer to only one AirProjector at a time. The present improvement has made it possible for one personal computer to transmit images to a maximum of five AirProjectors simultaneously.

4.2 Speeding up the network

A new organization called the "802 Committee" was installed within the Institute of Electrical and Electronics Engineers (IEEE) in February 1980. The "802.11" standard that was the first wireless LAN standard approved in 1997 specified a frequency of 2.4 GHz and a maximum communication speed of 2 Mbps. Two years later, the "802.11b" standard that increased the maximum communication speed to as high as 11 Mbps was established (the frequency was kept unchanged). Although IEEE 802.11b specifies a maximum communication speed of 11 Mbps, it is said that the effective speed is not higher than 3 – 4 Mbps since the wireless communication speed depends much on the communication environment, etc.

Assuming that the resolution of the personal computer screen is XGA, the maximum size of data that can be displayed on a screen is about 3 megabytes. As this figure suggests, KJ-100B, which is a product compatible with IEEE 802.11b, has the following problems.

- When images displayed on the PC screen are switched successively during data transmission on a real-time basis, the transfer of data takes so much time that the data displayed on the projector screen does not coincide with the data displayed on the PC screen.
- When the system is used in a heavy-traffic environment with a narrow radio-frequency band, in particular, the effective communication speed declines so much that the transfer of data takes considerable time regardless of data size.

In 2001, products which are compatible with "802.11a" (frequency: 5 GHz, maximum communication speed: 54 Mbps) made their debut. Then, in 2003, "802.11g" (frequency: 2.4 GHz, maximum communication speed: 54 Mbps) was established. Several products which are compatible with 802.11g have already been put on the market. The effective communication speed for IEEE 802.11a and 802.11g is said to be 20 Mbps to 25 Mbps. Compared with IEEE 802.11b, IEEE 802.11a and 802.11g permit transferring images about five times faster.

IEEE 802.11a and IEEE 802.11g specify the same maximum communication speed – 54 Mbps. They both have merits and demerits. IEEE 802.11a adopts a frequency as high as 5.2 GHz. Therefore, compared with IEEE 802.11b and 802.11g, the radio wave hardly goes a long way. The reason for this is that the higher the carrier frequency, the greater tends to become the attenuation of the carrier. To put it the other way around, the radio communication that tends to be easily attenuated is advantageous in terms of security because it can hardly be intercepted. Another demerit of IEEE 802.11a is the fact that it is incompatible with IEEE 802.11b that has become the most widespread. On the other hand, since the high frequency of 5 GHz is not used very widely, the effective communication speed with 802.11a is more stable than with IEEE 802.11b/g. IEEE 802.11g, which uses 2.4 MHz as the frequency band, is compatible with IEEE 802.11b that is most widely adopted. In addition, it offers a maximum communication speed as high as 54 Mbps. Nevertheless, since the frequency of 2.4 MHz is used for various types of devices, it can happen that the effective speed declines significantly due to mutual interference of those devices.

Therefore, we adopted a wireless module having chips compatible with IEEE 802.11a/b/g to permit the user to choose the optimum communication method according to specific operating environment.

4.3 Compatibility with high resolutions

At the time when we put KJ-100B on the market, many of projectors and displays were compatible with XGA. At present, one year and a half after the introduction of KJ-100B, with the spread of notebook-sized PCs and home theaters which are compatible with higher resolutions, projectors compatible with SXGA and displays (LCD/PDP) compatible with a wide screen are becoming widespread. KJ-100B is incapable of handling high-resolution screens and wide screens. The reason for this is that KJ-100B is not provided with a graphics controller for the processing of high-resolution images and that it cannot effectively cope with the increase in volume of data which necessarily calls for high-speed data transfer and high-speed image processing. Therefore, we adopted a high-performance graphics controller for the new product. This made it possible to increase the display capacity (speed) and secure the compatibility with high resolutions and wide screens. As a result, the scope of application of the system has expanded to cover not only projectors but also PDPs for business use (advertisements and display panels), PDP for electronic blackboard, etc. in the future.

4.4 Reduction of size

The new product is much smaller than the former one (KJ-100B), 1/2 in area required for installation and 1/3 in volume (**Fig. 2**).

Fig. 2 Reduced size of AirProjector
(top: KJ-100B, bottom: newly-developed product)

This dramatic reduction of size is attributable to complete change of the hardware configuration of KJ-100B as described below.

- A line simulation was introduced during circuit wiring to maximize the saving of space at the level of component layout and wiring.

- A mini-PCI module was adopted in place of the PCM CIA card.
- A new graphics controller chip with built-in video memory was adopted.
- The radio transmitter was subjected to simulative tests to determine the antenna arrangement with emphasis placed on footprints.
- Based on careful heat radiation design and thoroughgoing design review, the internal sheet-metal work and cabinet were made as compact as possible.

Fig. 3 shows the main circuit board. The board mounted above near center is the wireless module. **Fig. 4** shows the main circuit board provided with sheet-metal work and antennas.

The circuit configuration is shown by a block diagram in **Fig. 5**.

4.5 Compatibility with international standards

The new product and OEM products which are technologically based on the new product need to meet applicable international standards when they are shipped to the United States, Europe, etc. The former product employed PCM CIA and CF cards to implement its wireless communication functions. Therefore, the thoroughgoing testing and conformance to some of the international standards for wireless communications for shipment of the product to foreign countries had been implemented by the maker of the wireless module. In the case of the new product, which employs a mini-PCI module, the conventional procedures could not be applied. Therefore, in the early stages of development, we evaluated radio transmission characteristics with a number of different combinations of candidate wireless modules and antennas. Then, after giving careful consideration to the future deployment of the product, we decided the wireless module/antenna configuration. Concerning the antenna, we developed a 2.4 GHz/5.0 GHz antenna in cooperation with the antenna maker. As a result, a well-balanced antenna having good frequency characteristics for both frequencies could be obtained. By testing this combination of wireless module and antenna in accordance with the applicable laws and regulations of Europe, the United States, and Japan and obtaining authentication of the individual countries, it is possible to eliminate the need to repeat the same procedures when deploying the product in the future.

5. Conclusion

The new product has attained high speeds of data input and transfer through complete change of the hardware configuration of the former product. However, in the face of the growing demand for higher resolutions, animations, etc., the volume of data handled by peripheral devices to which the new product is connected is ever increasing. In addition, at exhibitions of multimedia, consumer electronics, and ubiquitous computing, they are active in demonstrating a home theater in their booth which simulates a living room, wireless transmission of audiovisual data, and so on. In the future, we would like to continue developing new products positively, including the study for adopting the image processing hardware CODEC, in order to make an entry into the above markets too (**Fig. 6**).

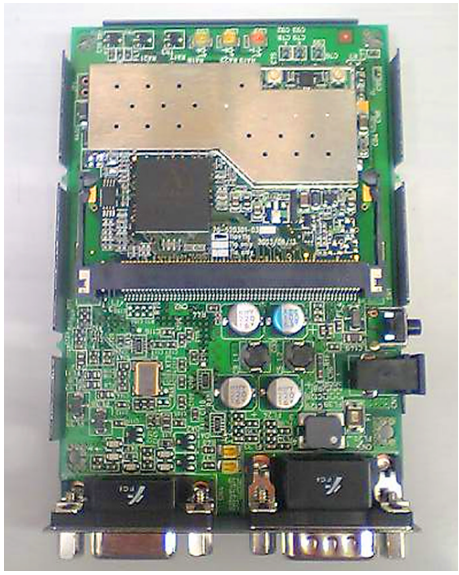

Fig. 3 Main circuit board

Fig. 4 Main circuit board provided with sheet-metal work and antenna

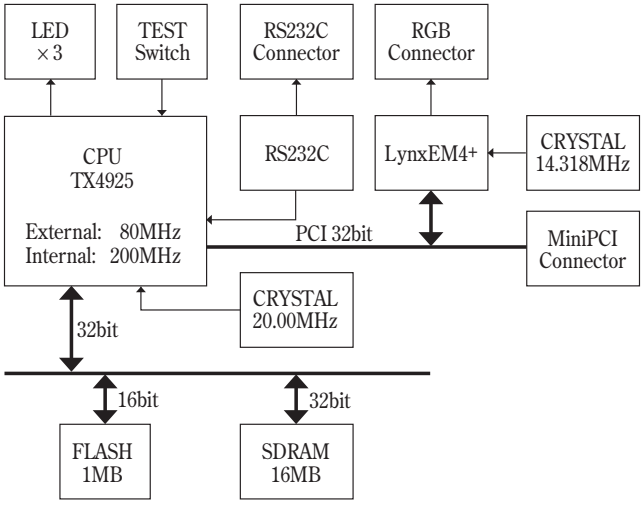

Fig. 5 Circuit configuration

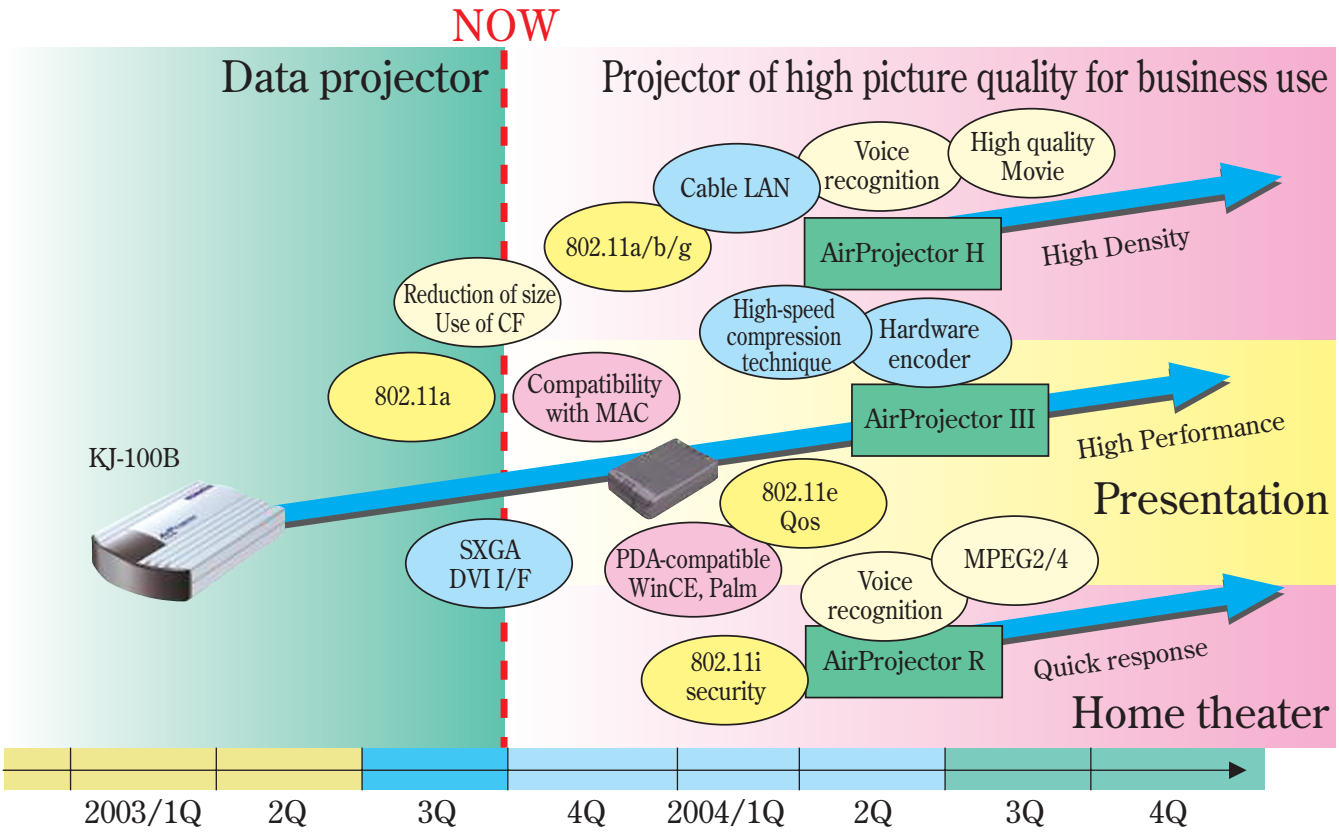

Fig. 6 Road map

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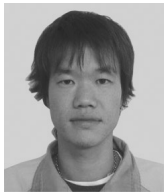

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[A few words from the writers]

Amid the growing market for projectors, Komatsu put on sale the world's first wireless presentation system "AirProjector" in 2002. Since then, more and more wireless networks have been built and similar products of the competition have been put on the market. Quick to perceive the market needs, we have successfully developed the new product that has been described so far. However, in order to fully meet the current user needs (e.g., compatibility with animations), it is necessary to tackle a number of new tasks. In the future, we intend to develop and offer new, easier-to-use products incorporating the leading-edge technology to differentiate our products from those of the competition.