Package Download   Package Management   i-appli Stereoscopic Viewing Support

Application Functions for Spring/Summer 2011 i-mode Models
—Providing New User Experience—

As the functionality and services of mobile terminals have diversified and become more complex in recent years, there has been an increasing need to improve usability. At the same time, there is also demand for functionality and ser - vices to meet users' constant desire for new experiences. Given these conditions, we have developed both a content package function and i-appli stereoscopic viewing function - ality for the Spring/Summer 2011 models. We have also implemented functionality allowing existing i-appli to be con - verted for stereoscopic viewing easily, so that their appeal can be improved.

Communication Device Development Department

Akira Shibutani
Hisato Ogawa
Tetsuro Susa

1. Introduction

NTT DOCOMO has introduced various new services in the past, such as i-appli and Chaku-Uta Full[®*1]. To use these functions and services, content must be downloaded onto the mobile terminal, and improving the usability of download operations has become an issue. As high-performance, sophisti - cated portable game devices and smart - phones have become more common, there is also a need to respond to the desire for more sophisticated user expe - riences. With these conditions, for the spring/summer 2011 models (**Photo 1**), we have improved the usability of con - tent download functions and have developed applications to provide con - tinually richer user experiences.

In this article, we describe a content package function able to download col - lections of i-mode content, and 3D viewing functionality for i-appli.

2. Content Package Function

2.1 Background

i-mode allows users to download a variety of content, such as i-appli appli - cations and Chaku-Uta Full music. However, when downloading multiple content items, the user must download each of them individually and this can require considerable effort, so we developed a content package function that enables multiple items to be down - loaded at once, and allows the down- loaded content to be centrally managed.

This mechanism makes a variety of content solutions and businesses possi - ble for content providers. For example, music album packages containing mul - tiple Chaku-Uta Full songs, photo col - lection packages containing images, or coupon packages containing ToruCa utilizing the attribute such as a particu - lar region could be distributed.

2.2 Content Package Download

There are two possibilities for

*1 **Chaku-Uta Full**®: "Chaku-Uta" and "Chaku- Uta Full" are registered trademarks of Sony Music Entertainment Inc.

| F-09C | N-05C | P-05C | SH-10C |

Photo 1 Spring/summer 2011 models

downloading multiple content items at once; either retrieve a content list including the URLs of downloadable content and then download the items in sequence, or compress the items in a single file, download it, and then unpack them on the mobile terminal. For the content package function described here, we used the download list method. This approach has the ben-efit that content providers only need to create the download list in order to pro-vide the service, and no additional pro-cessing is required for existing content. Also, no additional copyright process-ing is required. The download list can also be created dynamically by the server after the user has selected desired content, and this can facilitate imple-mentation of shopping-cart-style con-tent sales.

For the content package function, the download list is called a content package metafile, and it is coded in eXtensible Markup Language (XML) [*2]

format. The types of content usable with the content package function are shown in **Table 1**.

For i-appli, the function downloads an i-appli Bookmark [*3]. Depending on the i-appli, various user confirmation dialog screens must be displayed when it is downloaded, but displaying all of these dialogs in sequence could disrupt the continuity of the download. To pre-vent display of the user confirmation dialogs, the content package function only downloads an i-appli Bookmark instead of the i-appli, and when the user downloads the actual i-appli, the confir-mation dialogs are displayed.

The download process is shown in **Figure 1**. The user first downloads the content package metafile using the i-mode browser (Fig. 1 (1)). The func-tion checks that the mobile terminal has enough space available for the down-loads based on the content package metafile, and enables user operations to secure enough space if there is not (Fig.

Table 1 Package downloadable content

Images (JPEG, GIF, SWF)
Deco-mail pictogram
Decome Template
Decome-Anime Template
Schedule, i-schedule entry
ToruCa
i-motion
Music, subscription (Uta-hodai)
Melody (MFi, SMF)
Machi-chara
Kisekae Tool
i-appli
URLs (Web-to)

1 (2)). If enough space has been secured, the content is downloaded (Fig. 1 (3)). If an error occurs while downloading the content, the error is displayed immediately to show the user which item caused the error, and down-loading continues with the next item. After the download process has com-pleted, if any of the items did not com-plete, a dialog is displayed, prompting to download the undownloaded items again. If the user selects to download

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*2 **XML**: A markup language that applies mean-ing and/or structure to text or data by enclosing sections in character strings called tags. There are other well-known markup languages such as HTML, which is used to structure Web sites, but tags are pre-defined in HTML, while

the user is able to define original tags in XML.
*3 **i-appli Bookmark**: A special type of i-appli that holds the URL of a site for downloading an i-appli rather than the application itself. When the user selects an i-appli Bookmark, the i-appli download site is displayed. When the

i-appli itself is downloaded, the i-appli Book-mark is deleted and replaced by the down-loaded i-appli.

again, only the items not retrieved yet are downloaded again (Fig. 1 (4)). If the user does not select to download again or if all items downloaded properly, the content package list screen is displayed (Fig. 1 (5)).

2.3 Content Package Management

To make it easier to manage pack-age-downloaded content, we developed a content package list display function for managing package-downloaded content. This screen displays informa-tion including the content package title and the names, item types, and the download statuses of items in the pack-age. An image of this screen is shown in **Figure 2**.

Any of the content items can be viewed by selecting an item on the con-tent package list screen (Fig. 2 (a)). If the content item is not on the mobile terminal when the user selects it, a dia-log requesting the user to download the item again is displayed. If the user selects to download it again, the select-ed item is downloaded (Fig. 2 (b)).

In addition to downloadable con-tent, Web page URLs can also be included in a content package metafile. When a Web page URL in the content package list screen is selected, the selected Web page is displayed in the i-mode browser.
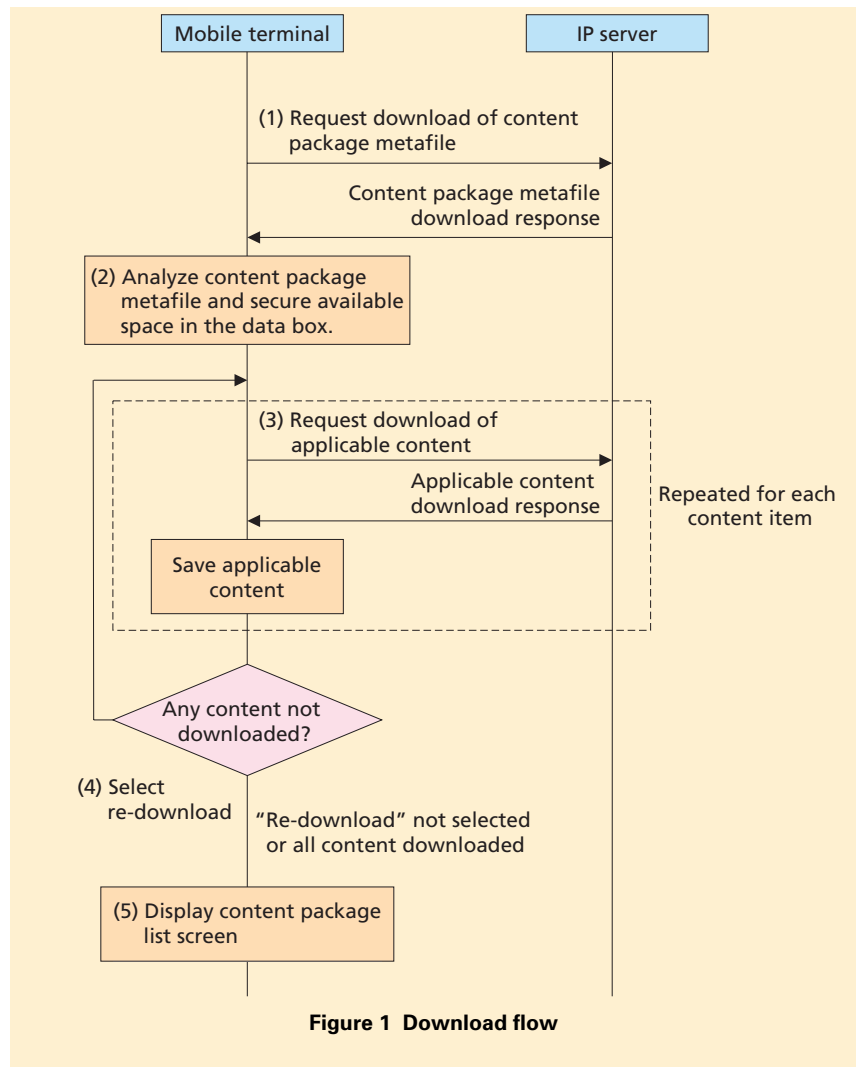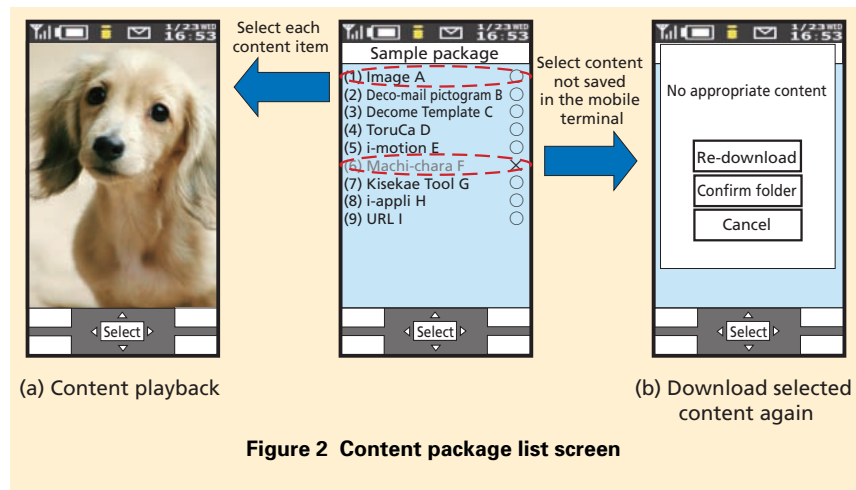

Figure 1 Download flow

(a) Content playback

(b) Download selected content again

Figure 2 Content package list screen

3. i-appli Stereoscopic Viewing Functionality

3.1 Background

Stereoscopic content has spread rapidly in recent years, in movies, TV, handheld games and other media. Also, with the appearance of stereoscopic displays that do not require additional accessories such as glasses, users can now view stereoscopic content more easily [1].

A 3D graphics engine has already been available for i-appli for some time. We have extended this function to obtain new stereoscopic viewing capabilities, providing a more realistic viewing experience. With conventional screens, objects are layered on top of each other, but with 3D display, a perception of depth can be created in this layered structure that can greatly improve visuals for applications such as games. As an example, flying objects can appear above objects on the ground.

To provide i-appli with support for stereoscopic viewing, we developed a new, faster and more expressive 3D graphics engine, and also simpler drawing functions that facilitate converting existing i-appli to support stereoscopic viewing. This was expected to enable more i-appli content with stereoscopic viewing to be released by the time the service was launched.

3.2 3D Viewing Principles

Some of the new i-mode handset models have 3D display implemented using the binocular parallax[*4] approach. Binocular parallax refers to the difference in the images seen by the right and left human eyes while they are viewing the same object, as shown in **Figure 3**, due to the separation between them. In other words, the brain senses the differences between images of an object viewed using both eyes and recognizes that it is a 3D object, as well as 3D positional relationships within it. This perception is affected by various other factors such as object size and shading, and these characteristics can be used together to create more natural stereoscopic viewing.

The parallax barrier 3D Display method is shown in **Figure 4**. When the parallax barrier is turned on, only the left-eye image reaches the left eye, and the right-eye image reaches the right eye. This can produce the effect of objects projected in front or behind the screen, even with the naked eye. Note that an i-appli can turn the parallax bar-
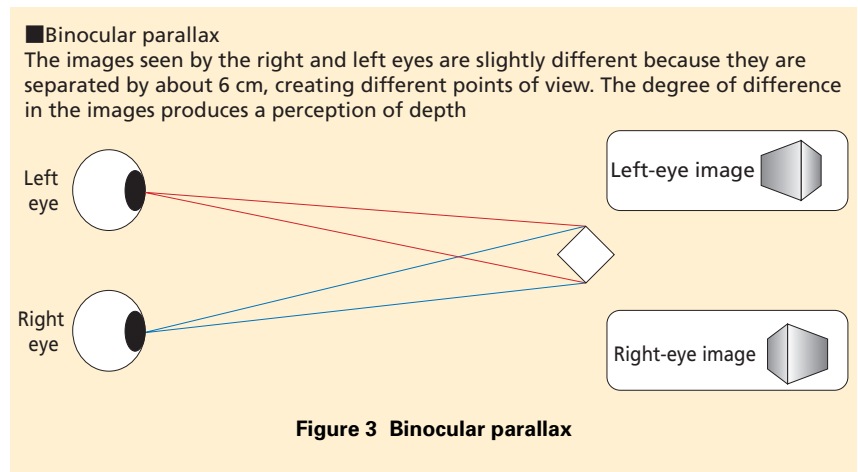

■Binocular parallax
The images seen by the right and left eyes are slightly different because they are separated by about 6 cm, creating different points of view. The degree of difference in the images produces a perception of depth

Left eye

Right eye

Left-eye image

Right-eye image

Figure 3 Binocular parallax

Display as seen from above

Red: left-eye image   Blue: right-eye image

Parallax barrier
Allows only the right-eye image to reach the right eye, and the left-eye image to reach the left eye
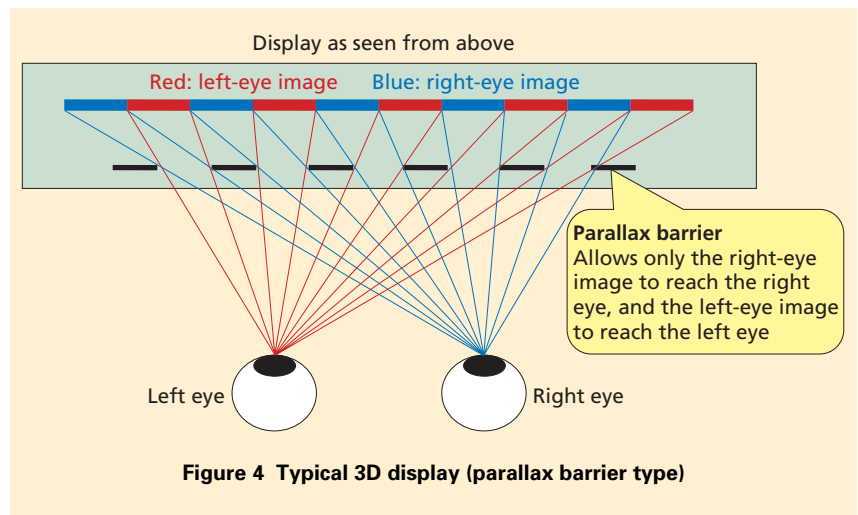
Left eye

Right eye

Figure 4 Typical 3D display (parallax barrier type)

*4 **Binocular parallax**: The difference in the images perceived by the right and left eyes due to the difference in positions of the eyes.

rier on and off, and can control the parallax direction (vertical or horizontal), so it can switch between 2D and 3D display, and between vertical and horizontal 3D viewing.

3.3 Stereoscopic Viewing Functionality in i-appli

Two drawing methods are provided for 3D viewing. The "Automatic drawing method" allows drawing in almost the same way as ordinary i-appli, generating the right and left-eye images automatically. For the "right-left drawing method," the i-appli must draw the right and left images separately to achieve the stereo image. We implemented "Canvas[*5]" optimized for each 3D graphics engine to enable stereoscopic viewing for i-appli.

1) Drawing Methods

• Automatic drawing method

We used the Automatic drawing method as a way of leveraging the appeal of existing games and other i-appli content by adding 3D support.

For a conventional 2D application such as a vertical-scrolling shooter game, objects are drawn in the same layer (in the depth direction), but this can be dramatically improved visually by simply defining depth information, so that objects in the air appear above those on the ground as illustrated in **Figure 5**.

With the simple drawing method, 19 layers are defined, with the display screen at a depth of

zero, and nine layers each in front and behind the screen, as shown in **Figure 6**, and 2D drawing is implemented by additionally specifying a depth in terms of one of these layers. Specifically, as shown in **Figure 7**, drawing proceeds nor-
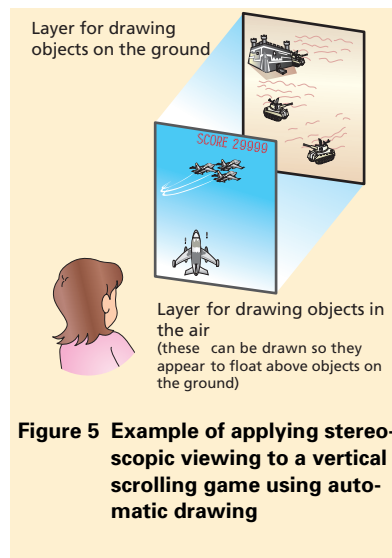

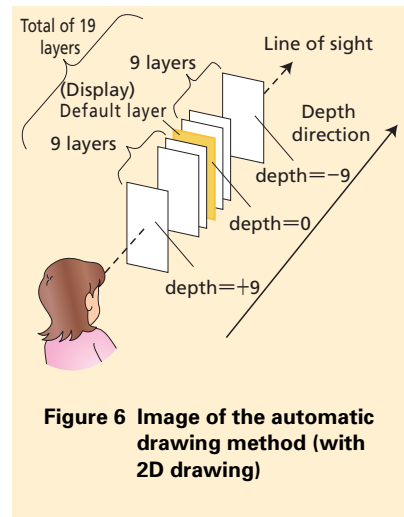**Figure 5 Example of applying stereoscopic viewing to a vertical scrolling game using automatic drawing**

mally, using an offset amount[*6] that is automatically calculated internally based on the depth information, to generate images for right and left eyes. This enables implementation of stereoscopic viewing.

On the other hand, if the content was drawn using the existing 3D

Figure 6 Image of the automatic drawing method (with 2D drawing)
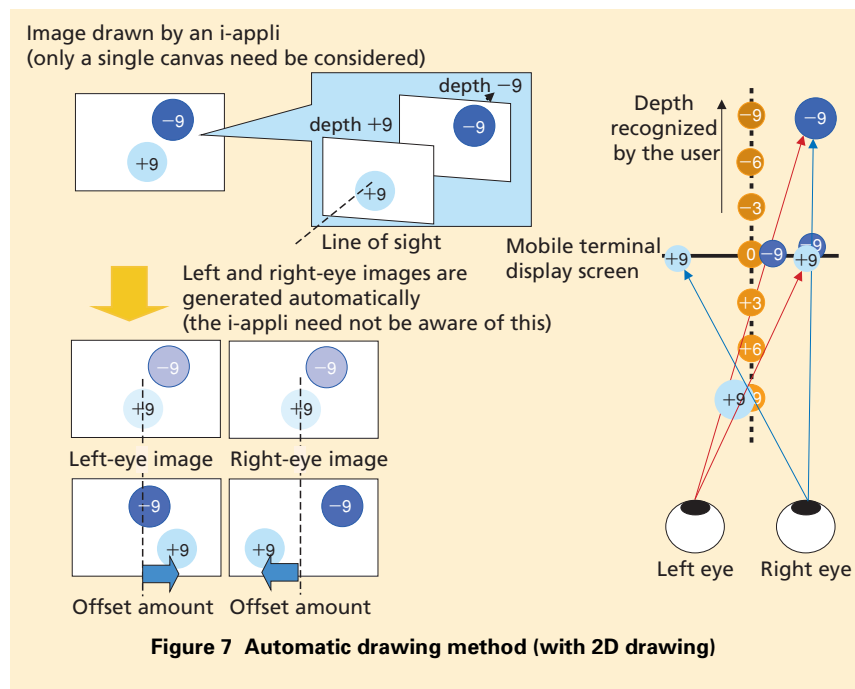
Figure 7 Automatic drawing method (with 2D drawing)

graphics engine, then stereoscopic viewing can be achieved by simply adding the parallax information. Stereoscopic viewing is possible with all 3D graphic engines sup - ported on all models that support stereoscopic viewing, but we have also added a new 3D drawing engine called MascotCapsule®[*7] eruptionST, that has additional effects and improved drawing speed.

Although 3D graphic engines perform internal calculations in 3D space, the engines only performed projection and drawing for a single camera. In contrast, stereoscopic viewing is only possible with two viewing frustums[*8], by specifying separation and focal distance (cam - era convergence angle[*9]) for the positions of right and left cameras (**Figure 8**).

A simple i-appli that uses a 3D graphic engine can be easily con - verted to support stereoscopic view- ing by adding only a few lines to the existing program source code. This greatly facilitates conversion of existing i-appli to support stereo -
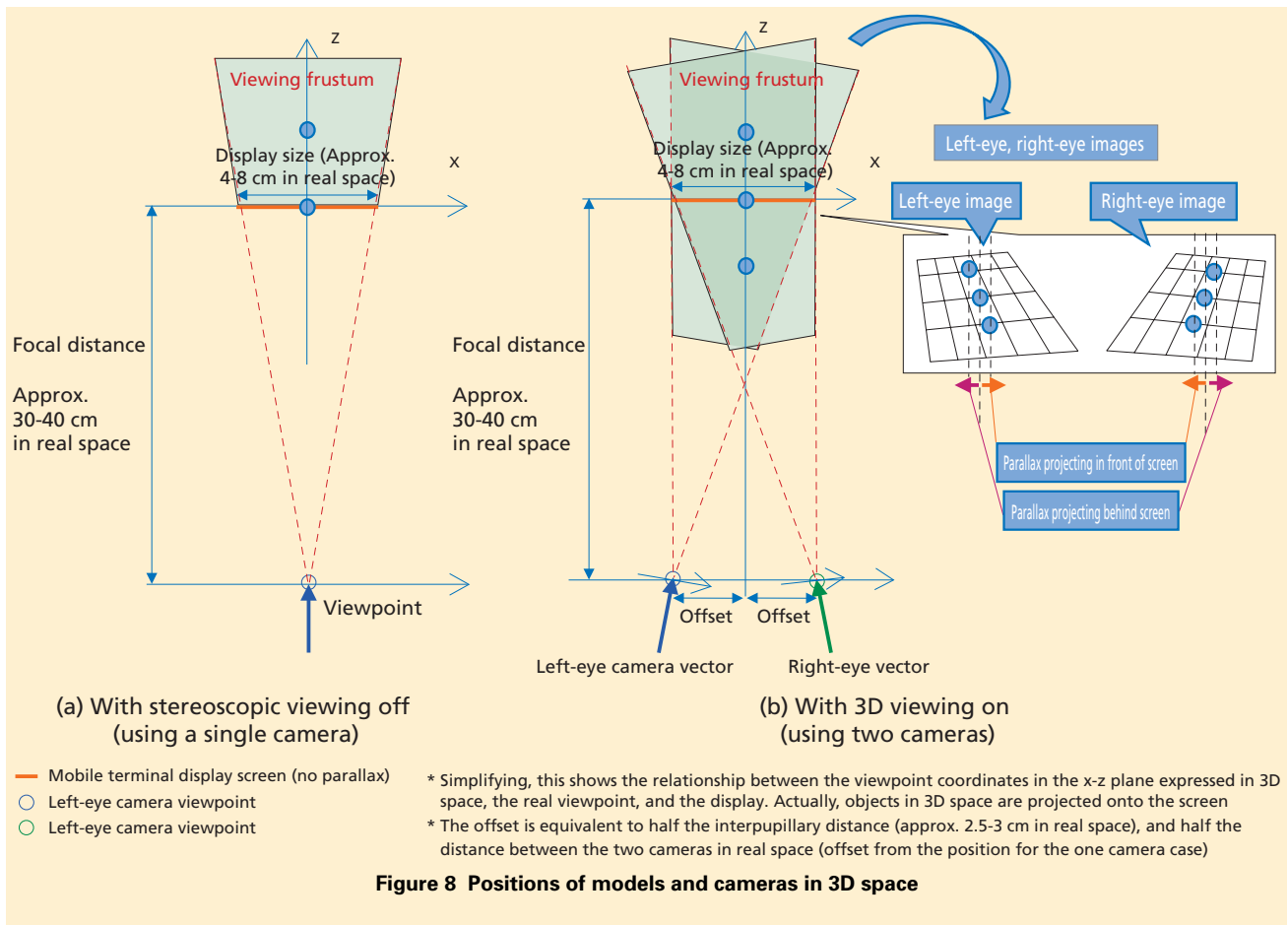
scopic viewing.

- Right-left drawing method

   With the right-left drawing method, an i-appli must consider parallax and draw each of the right and left-eye images separately. The i-appli developer must create both right and left-eye images .

2) Canvas

   We developed the following two types of drawing methods to support stereoscopic viewing in i-appli (**Table 2**).

(a) With stereoscopic viewing off (using a single camera)

(b) With 3D viewing on (using two cameras)

— Mobile terminal display screen (no parallax)
○ Left-eye camera viewpoint
○ Left-eye camera viewpoint

* Simplifying, this shows the relationship between the viewpoint coordinates in the x-z plane expressed in 3D space, the real viewpoint, and the display. Actually, objects in 3D space are projected onto the screen
* The offset is equivalent to half the interpupillary distance (approx. 2.5-3 cm in real space), and half the distance between the two cameras in real space (offset from the position for the one camera case)

Figure 8 Positions of models and cameras in 3D space

*7 **MascotCapsule**®: A registered trademark of HI Corp.
*8 **Viewing frustum**: Refers to the perspective projection of 3D space onto the drawing area, relative to the view point. The field of view expands in a pyramid from the view point, but

front and back clipping planes are established to avoid displaying objects very close to and very far from the viewpoint. The region between these clipping planes is called the viewing frustum (only objects within this visu- al frustum need to be drawn).

*9 **Convergence angle**: Defined as the angle made by the lines of sight from each of the left and right eyes to an object, when looking at an object with both eyes.

Table 2 Canvas types capable of 3D viewing

Canvas type	3D engine/2D 3D viewing drawing method	3D drawing (a) MascotCapsule ertuptionST	3D drawing (b) Mascot Capsule V3/V4, OpenGL/ES	2D drawing
StereoscopicCanvas	Automatic drawing	Drawing is done using almost the same procedures as for ordinary i-appli, and the right and left images are generated automatically (Parallax barrier is always on, no vertical/horizontal switching)		
StereoscopicCanvas	Right-left drawing	Not available	3D drawing is achieved by having the i-appli draw both right and left images (Parallax barrier is always on, no vertical/horizontal switching)	
Canvas implementing Stereoscopicable	Right-left drawing	3D drawing is achieved by having the i-appli draw both right and left images. Can control parallax barrier (on/off) and orientation (vertical/horizontal)		

- "StereoscopicCanvas[*10]," a dedicated stereoscopic viewing canvas

  StereoscopicCanvas is a dedicated stereoscopic-viewing Canvas and allows drawing using both conventional 2D drawing methods and 3D drawing methods. To realize 3D viewing, two images for the right and left eyes must be drawn, using the automatic-drawing or right-left drawing methods.

- "Canvas implementing Stereoscopicable[*11]," an extension to the existing canvas

  A Canvas implementing Stereoscopicable uses conventional Canvas drawing methods extended for Stereoscopicable. Only right-left drawing is possible, but detailed control of 3D viewing aspects is possible, such as turning the parallax barrier on and off, and switching between vertical and horizontal parallax.

4. Conclusion

In this article, we have described content package download functionality, which allows content to be downloaded and managed in packages, and i-appli stereoscopic viewing functionality. These new applications allow us to provide a more-convenient and richer user experience.

The new i-appli stereoscopic viewing function will be available to new i-appli, but we have also provided automatic drawing functions that allow existing i-appli to be updated easily for stereoscopic viewing. This enables the vast number of existing i-appli to revitalize their appeal as well.

In the future, we will continue to develop and extend applications in response to continually evolving user needs.

REFERENCE
[1] Tsuboi, et al.: "Mobile 3D Display Technology to Realize Natural 3D Images," NTT DOCOMO Technical Journal, Vol. 12, No. 3, pp. 18-24, Dec. 2010.

*10 **SteriescopicCanvas**: A class defining a Canvas specialized for stereoscopic viewing. When drawing using this class, stereoscopic viewing is always on, using parallax of the 3D display between images for the right and left eyes.

*11 **Sterioscopicable**: An interface that extends Canvas to support the stereoscopic viewing functionality. Canvas can be made to support the stereoscopic viewing functionality by implementing this interface.