

携帯端末向け WEB カメラ変換サーバーとその構成技術

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あらまし 近年、携帯電話や PHS 等に小型の携帯用 PC を接続してインターネットへの接続をするのみならず、これらに WEB サーバーへのアクセス機能が内蔵されている物まで普及の段階に来ている。一方、画像のデジタル化の技術により WWW サーバー内蔵のカメラも出現している。本論文では、インターネット・サーバーにおける画像伝送、処理の方法を考察する。さらに具体的に WWW サーバー内蔵のカメラの動画画像を主に静止画の WEB ページを扱える携帯端末へ表示可能な画像へ変換サーバーの構築方法を検討し、WEB カメラおよび携帯端末の可能性に関して述べる。

キーワード カメラ, WWW サーバー, インターネット, 携帯電話, 画像変換

A Study on the Structure of the Graphical Data Conversion Server of the Networking Camera for the Handy Terminal (I-Mode Phone)

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Abstract Recently cellular phone and personal handy phone are not only used for the data communication for Internet access, but also has the small LCD(Liquid Crystal Display) and the internal program for accessing the Graphical Data through Internet by itself. Furthermore, The Camera with WEB Server is used for getting Graphical Data by the image data processing technology has appeared. This paper describes the classification of Internet Server and graphical format. Then the design and construction method of the conversion server from WEB Camera to the still graphical data on WEB Server for the I-Mode cellular phone are proposed. Furthermore the conversion feature and performance are mentioned.

Keywords Cameera, WWW Server, Internet, Cellular Phone, Graphics Conversion

1 Introduction

Recently, the Internet has grown to an extent that it has become worldwide and with this many applications are being realized. It might be related also the improvement of the technology. In physical network, The ISO/IEC 8802.3(Ethernet (tm)) has become a very common technology in LAN (Local Area Network)[1], together with FDDI and ATM. In the case of WAN (Wide Area Network), ISDN, ATM, Frame Relay is utilized as common media, and sometimes ADSL and CATV Cable Modem are used.

A lot of information is accessed through the Internet including text data, program source codes, binary and graphical data etc. Researchers, teachers, students, technical people, economists, artists, traders, developers etc use this valuable tool to access information.

By offering multimedia data transmission including video and audio, the Internet has proved to be able to provide a lot of useful information for human activity. The Internet has developed not only having many camera sites but also Internet search sites specially for Internet cameras sites. [2][3] These cameras range from very big rotator mounted cameras to very small cameras with in-built pan/tilt functionality. An all-in-one network camera, which has WWW Server capabilities, is proposed. [4] The camera has a network port and by using the HTTP protocol. It is possible to push data to the internet/network without any need of server help. Connecting to the camera in a LAN network offers better performance as compared to connection from WAN. Support for wireless access users like cellular phone or handy phone is not very good as yet.

Current major trend is that both cellular and handy phones can support Internet access by accessing compact HTML (a subset of normal HTML) type of contents. Graphical data (GIF format data) can also be accessed on the WEB from these Handy Terminals. [5]

This paper describes the technology and structure of the Conversion Server for Networking Camera, which converts graphical data on WWW Server to still graphical data for Handy Terminal. We propose a method to construct a live still picture relay system for the phones and report its performance. Finally, we consider the application of them.

2 Overview of Internet Server

The Internet was initiated by the Military and University Research Network in the United State. At first, the hardware was a switched network, which had address. TCP/IP address was used the Hardware address. TCP/IP address and it's topology is basic.[6] Currently, TCP/IP uses logical address for global connection on various network media (Ethernet, FDDI, ATM for LAN, Analogue Phone line, ISDN, ADSL, ATM, Flame Relay for WAN, etc.). In the following, we discuss the Internet servers, which are based on the logical TCP/IP address.

Name Server(DNS)

The "BIND" package deals with the conversion of the Domain Name to the IP Address each other in essence. It maps the name onto an IP address with some data base table. In the Internet a lot of DNS have hierarchical layout and cooperate for name lookup services. Other application of Internet is served the IP address by it and is called "resolver". Fig.1 is illustrated the server-client model in Internet.

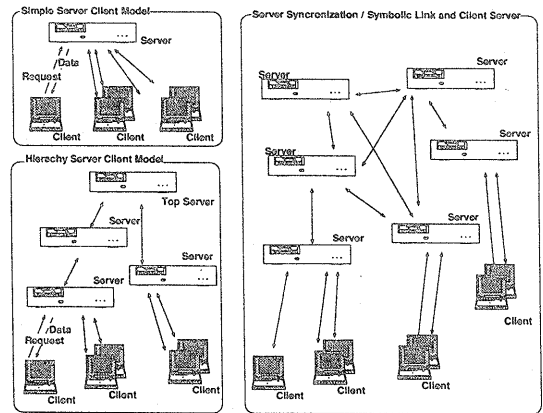


Figure 1: Server Client Model

Mail Server

This deals with the major Internet application, which is very popular. The "sendmail" is main part of it under UNIX together with the "sendmail.cf", the database of the mail delivery method. The Mail Server and DNS cooperate to decide the mails' route. The delivery concept is not a server-client model. The mail server delivers the mail to the corresponding mail server by using DNS's MX (Mail Exchange Record) and

sendmail description. POP (Post Office Protocol) Server also deals with mail and it is server-client model. The Mailing List (ML) is based on mail delivery mechanism.

News Server

The Internet News System is also another primitive Internet service. It is comparable to having a newspaper on the Internet. This server communicates with others by individual server settings. The reader/poster uses the News client software to access the server (This is server-client communication). This system is quite different from mail. A lot of unspecified users can read the posted article.

FTP Server

FTP server delivers a file (Source Code, Binary, Data, Article and etc.) This is also a primitive application. Data is stored in the storage of the FTP server and a user who needs the data on the FTP server uses an FTP client program. In a case whereby the FTP server is not able to communicate with another FTP Server the user will have to make great effort for searching the location of information. This is because there are many FTP Servers in the Internet. The "Archie" server is the good search server(engine) to resolve this problem.

Gopher and WWW server

The Gopher and WWW server are powerful Internet applications. In the Internet huge amount of resources are located and distributed into a lot of servers. The user sometimes needs to look for information by visiting many servers. By using Gopher, the user can visit many servers without having to open/close each server, the Gopher server navigate the path to the information with it's tree structure menu. It also covers the FTP/Archie information.

The WWW server is the wide area information system, which was developed by CERN. The main functions of WWW server are URL (Uniform Resource Locator) and Hyper Text. Users access the WWW Server by URL and get information, which is described in HTML. This system is Server-Client mechanism, but the Server link to each other by HTML description. The server and client communicate to each other using the HTTP. The CGI (Common Gateway In-

terface), which is an extension of HTTP, is a standard way for Web Server to pass users requests to an application program and to receive data back and to forward it to the user. Java is the client side program. The animation and motion video is realized by JAVA or Server Push mechanism, which is an extension of HTML. These technologies are used in the Networking Camera.

Other Realtime Application

The other realtime networking applications are the Chat, Network Meeting, and VOD (Video on Demand)/SOD (Sound on Demand). The IRC is major chat Client-Server system. The vat/vic/wb/sd/sdr, CU-SeeMee are meeting tools. Webtalk, Netmeeting/Netscape Meeting are WEB based meeting tools. The RealServer and IRIS have good function of VOD/SOD.[7]

Proxy Server/Cache Server

The Internet is very large network and has a lot of users. Sometime the servers' performance is not enough to process the many transaction, thus a proxy server/cache server is used. The CERN/Squid is famous proxy and cache server for WWW. Recently, many companies are connected to the Internet. Inside the company there is a closed world, like a small Internet (named Intranet.) Due to the fact that companies have a lot of confidential data, which needs to be protected from unauthorized outside access, companies partition their own network from outside by using a "firewall". The Proxy Server/Cache Server is effective in this case. The user inside the company network can access the outside server information via the Proxy Server/Cache Server, which operates on Firewall machine. It have only path of limited application for security.

3 Graphics Format

Digital Image Basic

Digital Camera consists of lens, zoom/focus mechanism, a prism (divide color to Red, Green, Blue) for high grade camera, picture sensor, and picture signal processing circuit (Analogue/Digital). This section describes the picture signal, signal format and file format

for computer. Before we describe the picture signal, let us first introduce on how to convert from picture to electric signal.

The picture sensor converts from optical signal to electrical signal. The picture sensor consists of many photo detectors on an LSI. The amount of the detector is dependent on its resolution (usually between 3 million to 20 million) and each unit of it is called a pixel.

Normal photo detector cannot detect color; the optical signal is divided to 3 component color (Red, Green Blue) by a prism. With this regard a color camera needs 3 picture sensors. Another method is to use a special filter placed in front of a picture sensor. The special sensor is tiled the very small color filter (Red, Green and Blue) which is placed to a photo detector on sensor. In this case the resolution of the sensor is down to one third.

The output signal from the detector is scanned and combined with one or three line electric signal on normal camera. The scan direction is important for reconstructing the picture. Also the format of line signal is important. The one signal line is named composite signal, which is frequency split method used for color and brightness of signal by some conversion circuit. A three line signal is called a component signal which is divided according to the brightness and color difference by another kind of conversion circuit. The composite and component signal are made for compatibility of B/W camera, which have only brightness signal. The computer can deal with the digitized RGB(Red, Green and Blue) signal directly. Fig.2 is illustrated the diagram of construction each signal.

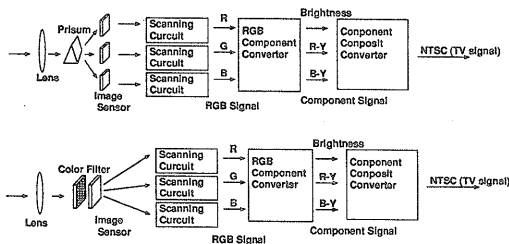


Figure 2: Picture Signal Format

The stream image of digital picture is converted to bit stream by pixel scan and by parallel-to-serial conversion for each byte/word/long word of pixel. The conversion manner of pixel scanning and parallel-to-serial conversion depends on the format. Fig.3 show it.

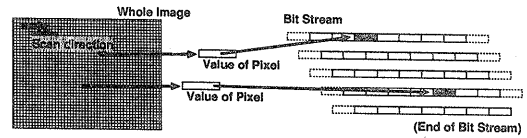


Figure 3: Digitized Picture

The digital image signal is made from component or RGB format. The component signal is digitized in the following manner. The analogue bright signal is converted to a 4 bit range and other R-Y, B-Y signal convert to 2 bit range for TV signal (NTSC). The RGB format is that each signal is converted to 8 bit range. This method is suitable for the high-grade picture but it needs huge memory to save the picture as well as processing. Usually, the color palette method uses far less memory. This method is like an index table. The value of each RGB signal is stored in the palette table. The value of each pixel indicates the table number (index). The color variation in this method depends on the size of the palette. But memory size of picture is very compact for saving as well as processing for computers. Fig.4 explains the palette method.

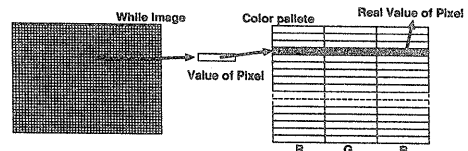


Figure 4: Color Palette

Data Compression

The picture data is very large in spite of using color palette method. Thus data compression methods are used for saving them. The following are the major data compression method.

- Run-Length Encoding(RLE)
- Lempel-Ziv-Welch(LZW)
- CCITT (Huffman Coding)
- Discrete Cosine Transfer (DCT)

RLE is simple. It is coding the same data repeat to the number of repeat and data.[8] LZW is used in many familiar computer compressing utilities example "compress", "zip", "zoo", "lha", and etc. It is also good for 1-, 8-, 24-bit image[9] Huffman Coding came with the Facsimile Technology described by the CCITT Group 3 and CCITT Group 4 Facsimile standard. [10,11]

Table.1: The graphics File Format

Name	Type	Compression	Platform	Application
Photoshop	Bitmap	No, RLE	Mac/Win	Photoshop
BDF	Bitmap	No	X Window	Exchange font
EPS (Encapsulated PostScript)	Meta File	No	Mac/Win/UNIX	DTP Application
FAX formats	Bitmap	RLE CCITT	All	Storage computer based FAX image
GIF	Bitmap	No	MS-DOS/Win/UNIX	Many application
Intel DVI	Multimedia	JPEG,Proprietary	MS-DOS/Win	Intel support motion video
JPEG	Bitmap	JPEG(DCT)	All	Still picture
Photo CD	Bitmap	Proprietary	All	Storage of deep pixel image
Machintosh Paint	Bitmap	No, RLE	Machintosh	Clip art, Screen dump, Artwork
Machintosh PCT	Metafile	JPEG, Pack	Macintosh	DTP, Paint, QuickDraw
Microsoft Panit	Bitmap	No, RLE	MS-DOS/Win	B/W Drawing, Clip art
Microsoft RTF	Metafile	No	MS-DOS	Document data interchange
Microsoft Windows Bitmap	Bitmap	No RLE	Win/Win NT	Storage format in windows
Microsoft Windows Metafile	Metafile	No	Win/Win NT	File interchange
MIFF	Bitmap	RLE, JPEG	X Windows	Bitmap and animation storage
MPEG	Audio and Video	DCT	All	Motion video
OS/2 Bitmap	Bitmap	No, RLE	OS/2, Win	OS/2 Application and other
PBM, PGM, PNM, PPM	Bitmap	No	UNIX, PC	Conversion for interchange
PCX	Bitmap	No, RLE	Win, UNIX, other	Exchange and storage format
PIC	Bitmap	No, RLE	MS-DOS	Paint program
QuickTime	Audio / Video	RLE, JPEG	Mac, Win	Motion Video for Windows and Machintosh
SGI	Bitmap	RLE	UNIX	SGI image file format
RAS	Bitmap	RLE	SunOS	Sun Raster file
TGA	Bitmap	RLE	MS-DOS, Win, UNIX	Storage and interchange
TIFF	Bitmap	RLE, LZW, CCITT, JPEG	MS-DOS, Mac, UNIX	Storage and interchange
XBM	Bitmap	No	X Windows	X windows GUI
XPM	Bitmap	No	X Windows	Storage of X windows pixmap
XWD	Bitmap	No	X Windows	X windows display format

Recently though, DCT has become very popular in JPEG and MPEG compression methods. JPEG is for still picture and MPEG is for moving picture. [12,13,14]

Vector File

Computers sometime use the vectorized data (indicate graphics shape) for graphics data expression. Metafiles and Postscript are major. The vector file is very small size for the data, which make graphics utility (CAD, Picture Drawing Tool, Graphical Tool)

Graphics File Format

There is many Graphics File Format in the computer world. Some of this depend on the platform(CPU, Display, OS). Other depend on the application. The majority is the official standard format and the defact standard. The Table.1 summarized the Graphics File Format.

4 Concept and Design of Server

Previously we proposed the networking camera with has WWW server. Usually the viewer of this camera uses a PC with a network interface. We proposed that a user far from the network camera use the ISDN network. For mobile user we proposed to use the personal handy phone and Notebook PC.

The basic service concept is that the user (anyone) of a networking camera can watch the live picture from anywhere. Handy Terminal technology has witnessed remarkable progress recently. They now have LCD for displaying bitmap image. These kinds of phones also have the functionality of Internet access and can display the portion of WEB Server. We decide to use this technology for our implementation of our concept.

The following is the concept of the Graphics Conversion Server for Handy Terminal

1. The server platform can be used PC server(Normal Internet configuration).
2. The server have the function of the Compact HTML Web page.
3. The server can connect to Internet directly.

4. First version of the server support only still picture. (but in feature, It support some moving picture.)
5. The still picture on the server replace on the access. (on demand)
6. The Conversion Server have the possibility to support multiple camera. (Multi-tasking does Multi Camera support.)
7. The conversion time is enough to rapid for phone access.
8. Easy to access from Handy Terminal.

5 Structure of Server

The system and the image data stream is illustrated in Fig.5. The users request is sent as special HTTP(CGI) from the Handy Terminal. It goes to the gateway of the handy terminal Internet support and is converted the normal HTTP(CGI). The gateway connects to Internet, then the request reach the WWW server program on the Conversion Server. The CGI program of WWW server communicates to the Networking Camera, gets the still image data which is formatted the JPEG(Motion JPEG), and converts to GIF format. And it also does some image processing (resolution, color palette and etc.) to fit the Handy Terminal Display.

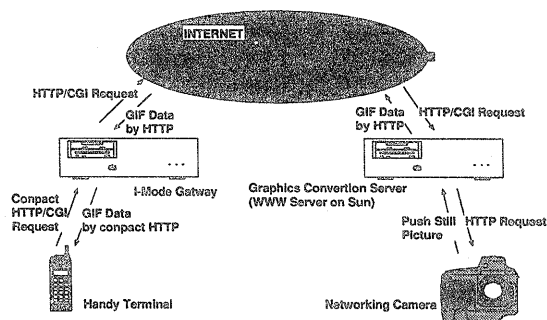


Figure 5: The Function of Conversion Server

The conversion program is mainly two portions. one is the get the still image data from the networking camera via network. The other is the converter from JPEG to GIF. The graphics processing also added for small Handy Terminal's LCD. These portions are associated by WEB's CGI on the conversion server. The current practical implementation is on the Sun Microsystem's Ultra 30 with Solaris 2.6(UNIX). The CGI

Program is coded with "Perl" script which is powerful interpreter language. The block diagram of the current implementation is Fig.6.

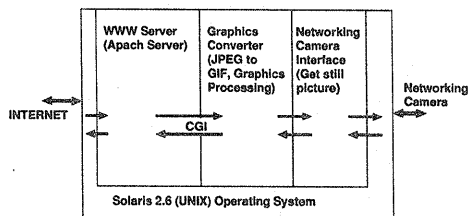


Figure 6: The Internal of Conversion Server

6 Feature and Performance

The results of our implementation have shown that a person with a Handy Terminal and within mobile phone service area can connect to the Networking Camera and get a live image. The conversion time from JPEG to GIF is less than 1 sec. This is far less than the display time of Handy Terminal.

Technically, the Conversion Server under WWW (CGI) technology is a small code and portable which can be applied to various kind of Internet server. If other gateways, which support other kind of wireless phone network, are connected via Internet, it is able to support the other kind of Handy Terminal.

7 Conclusion

The Conversion Server of the Networking Camera increases the Internet use and expands its service area. The implementation and mechanism is very simple by the assistance of good WEB interface. The conversion program is fast enough to service the Handy Terminal communication.

Previously everyone thought that normal live camera applications are for desktop computer that are connected to a network or for notebook computer connected digital wireless network. This server makes a inference of the live camera application by easy to watch it.

8 Future Plan

We have successfully implemented a simple graphics conversion server for viewing networking camera images on Handy Terminal with

LCD display (I-Mode). We are considering several targets for our future activities, including the basic functionality and performance tuning that are effective for processing lots of transactions. We also intend to improve on the image processing for new coming Handy Terminal. Other targets are the possibility of application. We are considering the followings.

1. Control and browsing with Handy Terminal.
2. Networking Camera link site and the picture collection site. (Automatically Gathering the picture, like a robot for WEB Gathering)
3. Networking Camera chat and Networking Camera party.
4. Application oriented WEB and picture link.

9 Summary

This paper focuses on the networking camera and proposes a method of service for viewing live picture on handy terminals. We summarized the Internet server technology. Next we discussed the graphics (image) data and its format for transmission and storage. Both technologies are the basis of this proposal. We have the concept of service that networking camera's user needs the live picture in anywhere and any-time. We aimed the Handy Terminal function that can access WEB server. We proposed, designed and implemented the conversion server. We hope that this is one of the starts of the networking camera's application. With this regard, we expect many network culture will come up.

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