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Digital Campus over the Internet WEB: Extending the Opportunities and Possibilities beyond the Real Campus

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1. Introduction

Recently, e-Learning is showing a symptom of world-wide explosion in educational fields [1,2]. This creates the growing needs of innovative and technological advances on digital environment in educational institutions. Harnessing these circumstances, we are proposing a Digital Campus over the Internet WEB, extending the opportunities and possibilities beyond the real campus. It is an alternative campus of our dream over the Internet WEB, for which we employ campus metaphor and avatars reflecting the members of the real university for its realization of campus amenity, combining Web3D technologies, contents delivery and user communication mechanism over the Internet. Owing to 3D representation, any users can feel the atmosphere of the real campus, walk around in the real 3D campus environment, and attend lectures and seminars anytime, anywhere that they provide.

2. Digital Campus

2.1 Motivation

MEXT (Ministry of Education, Sports, Science and Technology) has issued two representative official notices that approve distant learning styles in education in 1998 and 2001, respectively [3]. These two notices have received much attention in academic society that might involve the extension of the opportunities and possibilities in university education.

Digital Campus has possibilities to sweep away some predicaments that current education system holds, and to get the following advantages:

- No Capacity limit of Students and/or Area,
- No Entrance Examination,
- Provide Personalized Educational Contents,
- Realize Networked University over the Internet WEB.

2.2 Technical Features

We summarize the features of Digital Campus as follows.

- Web-based 3D Campus over the Internet

The system is WEB-based information system over the Internet WEB and has layered structure. The source programs are transferred from WEB server, and are rendered on client-side PC's to give 3D objects in WEB browsers.

- Avatars for Awareness of People

Users (= Students and Lecturers) of Digital Campus are represented as avatars, and can be seen from other users. Avatars hold personal data of the user to represent his/her tastes, characters, and himself/herself.

- Customizing/Personalizing Digital Campus

WEB-based customization and personalization methods are deployed for users both on server-side and on client-side. The system has the following aspects for personalization, namely, (1) educational contents which we have

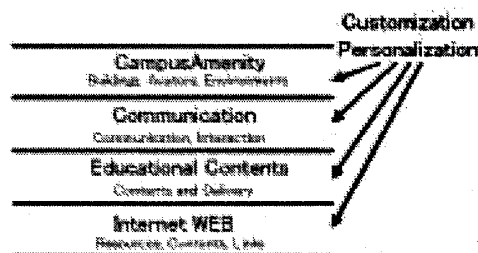


Figure 1: Layered structure of Digital Campus

accumulated in real campuses and their delivery, (2) campus amenity to offer personal view of Digital Campus, (3) hyperlinks that are embedded in 3D campus.

- Leaving/Retrieving Messages in 3D space

Leaving messages in 3D space and reusing them is one of indispensable functions for Digital Campus. This program has functions to add, delete, and edit homepages using server-side programs, which make it possible for any users to update the contents.

- Interactive and Symmetrical Communication

Lecturers-to-students, students-to-students can communicate each other, one of which is home delivery of lectures from university, and the other is giving lecture from home due to symmetric nature of the WEB.

- Scalability of the system

In the system, 3D space rendering is carried out on client PC's, and no need to download each time avatar or user moves in a virtual space. The system described here works as a server/client model. Further, our advanced Digital Campus, which we've been working on, works in P2P model, which provide more scalability.

- Digital Campus as a 3D Portal

Digital Campus is a portal to the WEB sites in the Real Campus. Hyperlinks to campus WEB sites are embedded in 3D space.

3. System Model

The system model of Digital Campus is constructed in a layered structure as shown in Fig.1.

3.1 Campus Amenity Layer

- Buildings and Environments

Digital Campus consists of a set of buildings and its supplements using 3D blocks and 2D textures/images. These individual modules of Campuses are then linked together and integrated into a full fledge Digital Campus. Walk-Through around and inside of each building or traversing from building to building is also accessible. In buildings, we allocate sensors to catch users' locations, behaviors, and software events to invoke application software.

- Avatars and Users

Every participant of Digital Campus is represented as

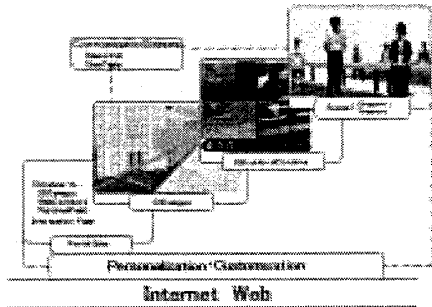


Figure 2: Customization in Digital Campus

Avatar, and can be aware of each other. Each user can be distinguished as an individual avatar, and can recognize other users mutually. Avatars are created out of captured figures.

3.2 Communication Layer

Communications between lecturers to lecturers, students to students or crisscrossing, can be activated in video and audio in live mode.

- Visualized Communication with Other Users

Visualized communication is created in two modes, (1) a direct eye-to-eye communication using streaming devices, and (2) a visualized communication using avatar characters.

- Text-based Communications

Users can also communicate in literal mode using Web-based chat and shared whiteboard.

3.3 Educational Contents Layer

- Educational Contents

We have On Demand type lecture using WEB streaming, and Live Video transfer mechanism using WEB-camera. Teaching materials are stored in backend database. Some of these materials are synchronously transferred as shown in Fig.2 using WEB-based e-conferencing system.

- Contents Delivery

There are two programs for presenting educational resources or handouts. One is for students, and another is for lecturers.

3.4 WEB Customization and Personalization

We have this customization layer in order to offer fine-grained environments for individual users. Users can customize the following aspects of Digital Campus.

- Campus Amenity

Objects in Digital Campus are written with a text-based markup language 3dml, which enables us to identify the subtrees of a given source using anchors. This mechanism offers short cuts for walkthrough.

- Educational Contents

WEB personalization on servers and WEB adaptation mechanism for retrieving user's own notes down to multimedia appliances are applied.

- Hyperlink Connections

Our system also works as a campus portal site, and we can embed hyperlinks to the objects it holds.

4. Prototype System

We here show a prototype system and its software modules. The system is developed as a WEB-based server/client information system.

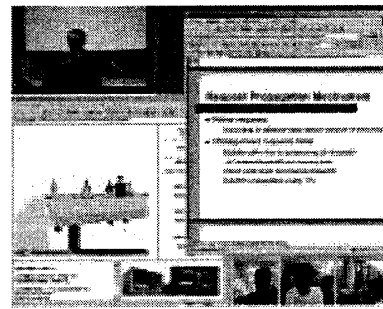


Figure 3: Overview of a Prototype System

- WEB servers

Store and manage 3D Architectural constructs, 3D objects inside building, Avatar data, and sensors.

- Backend Database Server

This server works as a participant management Database Server including personal and location information. Users who walkthrough inside various buildings or points of the campus can recognize other users in the same building, and enables to actually have conversation with them.

- Boot application request database

Standard styles of boot requests are stored in the server to invoke appropriate applications, on clients such as NetMeeting, reflector type conferencing server, and chat software, and so on.

- WEB servers for educational contents

WEB for storing teaching material data, contents, etc. A timetable for lecturers is incorporated.

- Residence software

As programs on browsers (JAVA script, etc.) cannot run the software in local PC, residence programs are set for use. When there is a boot request, the residence program for booting software boots the local software. User with no updates for over a fixed period of time is decided as being logged out and his information is initialized.

- Application softwares

Commercial software is utilized by running within the Digital Campus, other than WEB browsers.

5. Preliminary Experiments

We've so far held two Distant Collaborative Seminars as preliminary experiments, integrating SCS (=Space Collaboration System), Internet, MBONE, IP over ATM and other information infrastructures:

- (1) Multimedia Distant Collaborative Seminar between two Domestic Graduate Schools of Informatics (2000, December),
- (2) Distant Collaborative Seminar between JAPAN and the US (2001, December).

We mainly deploy the Internet as the base of Digital Campus, and also other Information networks as well. We deploy embedded mechanism in broadband networks where they are available for accessing to digital assets over the Internet using WEB integration.

References

- [1]DistanceLearning, <http://www.computer.org/distancelearning/>
- [2]Okawa,K.,Ijyuin,Y.,Murai,J., GIOS project, IPSJ Magazine Vol.42 No.1, pp.51--57 (2001.1)
- [3]MEXT, <http://www.mext.go.jp/b~menu/shingi>