Shift to Cyber-I: Reexamining Personalized Pervasive Learning

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Abstract— **Recently, there have been lots of researches on how to provide personalized services to different users according to their personal characters, needs, situations, contexts and so on. Such personalized services are often based on users' profiles provided by the users in the beginning, and users' records or experiences in using corresponding systems during a certain period. However, different systems or terminals collect user information independently and cannot share the user's personal information collected by these different systems/terminals. As a result, each system can only utilize the limited information collected by the system itself to provide services or recommendations, thus cannot meet different users' needs in varied situations across different systems/terminals. Therefore, it is still an open issue how to gather, share and utilize various kinds of personal information in order to provide users with effective personalized services at the right time and right place, by the right means. In this paper, we firstly describe the concept of Cyber-I (Cyber-Individual), a counterpart of an individual human use in the cyberspace. Cyber-I aims to provide a better environment for users to obtain what they may really need on the Web, and it can be considered as an innovated possibility of web usage scenario in the near future. We reconsider and reexamine personalized pervasive learning from the perspective of Cyber-I with two case studies, which use mobile devices (such as iPad, smart phone, and laptop), and can be regarded as the best practice of Cyber-I.**

Keywords-Cyber-I, pervasive learning, personalized services

I. INTRODUCTION

The wide usage and quick spread of the World Wide Web have obviously changed human being's daily life such as the way we act, work, and learn. To connect with the Internet, the use of certain devices (i.e., PC, laptop, mobile phone, etc.) is necessary. As the famous slogan of Nokia Corporation "*Connecting People*" shows the devices that can assist users in interacting with the Internet are getting more and more smart, powerful, and with high mobility as we expected [4].

Devices are no longer just simple tools that allow users to access the Internet but also become an operation center where they interact with the cyber world. Messages, requests and responds are utilized as a fundamental factor [2] for communicating between something in the cyber world and users in the real world. On the other hand, they may also represent users' thoughts on certain things. Thus, lots of researches have been done on how these messages can be documented as personal profiles, and/or become specific metrics for systems to provide recommendations or services to users. The expected scenario shall be that the right information will be delivered to users based on cross-calculation of their profiles, and meanwhile, can be received by users through certain devices at any time and any place [3].

Therefore, the profiles here are supposed to require enough information for specific purposes to serve the mentioned goals. To take common recommendation service in e-commerce system for instance, the more detailed information users set in their profiles are, the more irrelevant results will be filtered out while they query for certain products. However, the way profiles are gathered for generating the user model is still case-dependant. The information stored in profiles that can be computed is very limited, that is, the user model can only be created and utilized in a scope of specific domains [20][21]. In other words, the so-called user model still cannot be an essential factor for system to envision the whole of the user.

Thus, as a partial contribution to the issues addressed, the general concept and possible usage scenario of Cyber-I (Cyber-Individual) [22] is conceived in this study. It works as a counterpart of a human individual who assists him/her in gathering and managing all the related information when he/she acts, and, most important of all, can make use of this information to serve other specific purposes, such as learning and gaming, that the human individual may be involved him-/herself. That is, everything can be obtained in a computing environment through Cyber-I as long as he/she sends a request out to his/her Cyber-I.

The rest of this paper is organized as follows. Some works related to the pervasive learning issues are introduced in

Section 2. The concept of Cyber-I is introduced in Section 3. Section 4 discusses two case studies of personalized pervasive learning based on our previous implemented systems in the context of our proposed Cyber-I concept. And we conclude this paper in Section 5.

II. Related Works

Three major kinds of works including ongoing systems and research issues related to personalized ubiquitous/pervasive learning will be introduced and discussed in this section. The first one is related to systems that support personal language learning, and the second one is about how the personal assistance is delivered. The third one is introduced about the customized guidance issues.

A. Personal Language Learning

Language learning is one of the major topics in the ubiquitous learning research field since language is contextualized and the language-thinking pattern is assimilated in the real world [5]. For example, Miller and Gildea [6] described how children acquire vocabulary faster with the method used outside of school, by relating words to ordinary conversation, than with the traditional methods based upon abstract definitions and sentences taken from external contexts. With the personal learning information retrieved from learners, the proposed system [7] can help learners by sharing the past experiences and presenting the right question at the right place and right time, by detecting the context of the learning situation and solving the confront problem immediately, and by providing the right information via wireless network. In addition, there are more similar works like LOCH in [9] which integrate the advantages of devices, such as GPS and PHS (Personal Handy-Phone System), to achieve the so-called outdoors language-learning environment. They provide personalized and contextualized access to allow learners to apply knowledge learned from classrooms to the actual town for improving the foreign languages skill including the vocabularies.

B. Personal Assistance Delivery

To provide personal learning assistance, AirTransNote [10] has been developed to manage notes written by learners on the papers and enables the teacher to browse through the notes or show them to the students. Lindquist et al. [11] described the design and use of a mobile phone extension called Ubiquitous Presenter, which allows students to do active learning exercises in the form of text or photo messages. Distance education and learning have been widely used for many years, and they allow students and professors from different geographic locations to share and teach/learn each other.

C. Guidance Issues

A number of technologies have been developed to support the museum visitors. Museums have always seen themselves as having an educational role. Laurillau & Paternò [12] showed how to support collaborative learning in museum visits and presented an example application based on mobile palmtop systems. Chou et al. [13] introduced a context-aware museum tour guide to adjust recommendations to the interests and contexts of individual visitors and to enable them to share their experience with others. Visitors enter the museum with ubiquitous devices. MyArtSpace [14] is a service that delivers personal learning experience that traverses the museum and the classroom through different kinds of portable devices on the Internet. By typing a specific formatted code in devices, learners can obtain exhibit information, text-based and/or multimedia-based, related to the arts.

D. Problem Definition

In the literature, it is not difficult to understand that lots of researchers pay emphasis on the development of personal ubiquitous/pervasive learning environment and the use of corresponding devices to enhance the learning process. Some fundamental issues are raised while there are many articles addressed the restrictions, such as the analysis of user model/profile and the share of usage experience, under the ubiquitous/pervasive environment. Since learning resources can be regarded as major component of learning process, it will be a challenge for researchers to figure out what kinds of learning resources shall be delivered to learners. Some researches are addressed to represent the current status of ubiquitous learning. However, nearly all of them make use of their own strategy (i.e. profile or user model) to achieve the personalization. That is, if a learner joins in such kinds of learning systems, there will be, more than one, profiles for describing him/her for different purposes. It is obvious that the more detail user profile is, the more personalization process we can achieve. However, the creation of user profile/model now is still scattered and is gathered for only specific purposes, that is, it can only represent a specific aspect of a single user. But, single aspects are not sufficient to describe a user.

In this situation, finding a way for collecting and using these scattered profile information becomes more and more important for researchers whose aims at personalization services, in many aspects, provision. In addition, how the information is shared is also a fundamental issue that we shall concern.

For this reason, Cyber-I was proposed to be a preliminary solution to issues addressed above. It takes user experience in every single aspect into concern as factors while providing services for other purposes. For instance, the profile for working may be referred by the one for learning or other purposes for the same specific user. We will introduce the concept of Cyber-I and how it works in the following section. And we will show the possibility of Cyber-I by reexamining our past achievements through the concept of Cyber-I.

III. An Overview of Cyber-I

This section includes two major parts. First the need of Cyber-I will be addressed in the beginning. Followed by the instance, we will give a brief introduction to the proposed Cyber-I from an abstractive perspective of view.

A. The Necessity of Cyber-I

Lots of things may take place around human beings in his/her daily life. It is impossible for human beings to cope

with everything only by themselves. The concept of Agent was proposed to assist human beings in dealing with specific purposes. One noted application is customized service provision like personal recommendation in e-commerce or adaptive tutoring in e-learning.

In provision of personalized services, systems can make use of the related information, such as interests, habits, and histories, set by users to provide solutions to individual's different needs. However, the way human beings act depends on his/her inner thoughts no matter in the subjective/objective perspective of view. In this situation, the use scenarios of agents may differ from each other. And, thus, it is not difficult to find out that some drawbacks may raise while the use of agents as follows:

- Usage Scenario

  A user can make use of agents to cope with lots of things, but an agent can serve for only a specific purpose in current environment. That is, there may be two agents in while user would like to operate the different services like which pages shall be opened and what kinds of things shall be downloaded. In this situation, users have to consider lots of scenarios that he/she may need agents to help. In other words, users have to maintain all the possible agents related to him/her.

- Data Collection, Storage, and Sharing

  As stated, agents can serve if there is sufficient information provision by users. In fact, though agents work for different purposes, some user information, such as interests and habits, shall be the same for a user. In this situation, there may be lots of duplicated information stored in different agents. It is because that the information cannot be shared automatically only through user's input. It causes that an agent only utilizes limited information user sets in advance to proceed results. That is, in current architecture, an agent can only consider a single aspect of user's needs, and cannot take a comprehensive review.

- Period Persistence

  The agents existed because of users' specific needs, and it can only exist in a limited period of time. As soon as the needs are terminated, the data along with the specific agents will also be eliminated. That is, the users' information for specific purposes cannot be retained for further usage in the future.

The concept of Cyber-I will be discussed in the next section to provide a reexamination of usage scenario of agents.

B. General Concept of Cyber-I

The mirror reflects what human being acts in the real world, and the so-called mirror image can be regarded as human being himself/herself who exists in the opposite world. No matter what kinds of actions you perform, the same ones will always appear on the mirror. However, the mirror image is just a copy of you, and, more specifically, it copies only the shape of you. It contains no further information about your actions such as the reasons why you do and/or the process what you go through.

The concept of Cyber-I (or Cyber-Individual) [22] can be considered, somewhat, as an extension of individual's mirror image. It is not only a copy of individual's outer shape, but contains a rational copy, both inner states/thoughts and outer behaviors, of an individual. The information of Cyber-I in the cyber world can be inherited from the individual in the real world through possible computing devices such as cell phones, personal computers, sensors, and so on. The mentioned information can be regarded as a series of behaviors, like the way individual browses the Internet or the way individual utilizes different devices, or the personal information, such as interests and habits. More specifically, everything an individual does in the real world may be reflected in the cyber world, and be stored as profiles or logs through specific format as shown in following figure.

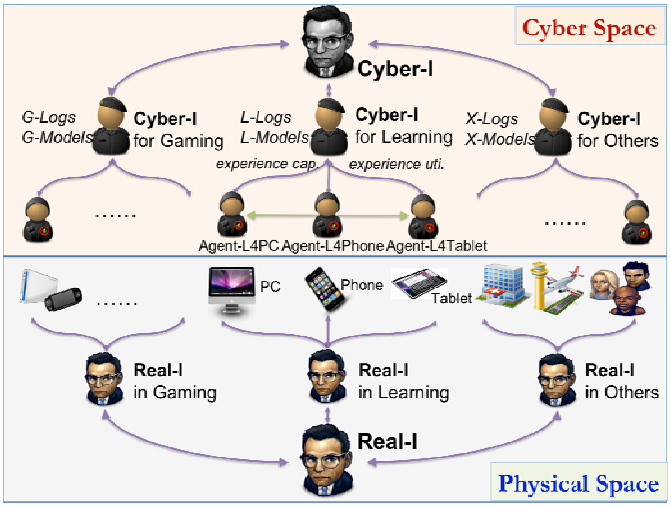


Figure 1. Possible Scenario of Cyber-I

Figure 1 outlines the possible scenario of Cyber-I. The Cyber-I and Real-I are symmetrical existence. What Real-I does in the physical space, or real world, will be reflected to Cyber-I in the cyber space by converting the related information, such as behaviors and thoughts, gathered by underlayer agents to specific logs. The agents are the ones that may have direct interactions with Real-I. Corresponding agents will capture the information, as much as possible, while being used, and synchronize them to upper layer. In this situation, the information for modeling the Cyber-I in specific purposes can be enriched.

For example, if an individual like to utilize different portable devices, such as cell phone or tablet, to finish the assignment from instructors. There may be two agents, Agent-L4Phone and Agent-L4Tablet, to assist him/her in obtaining related learning resources and/or in filtering some irrelevant content so that he/she can do the assignment by using such devices. And some possible behaviors may appear under such usage scenario. An individual may prefer to see the multimedia resources on tablet than on cell phone since the limitation on display and network capability. In this situation, once when this learner choose to use another device, i.e. PC or laptop, for

his/her next learning platform. His/Her Cyber-I for Learning can make use of the captured experience to be one of the references. Thus, with support of Cyber-I, system does not need to collect and analyze the users' personal information from the beginning. The system can use the previous experience from other devices instead. The overall process is like what an individual is expect to do in the real world.

In other words, Cyber-I identifies individual's counterpart who lives in the cyber world. Unlike the real world, it is more flexible in cyber world, that is, Cyber-I has extendibility. As shown in Fig. 1, each layer, agent layer or Cyber-I for specific purposes layer, can be vertical extension for different usage, and can also be horizontal expansion for different purposes. For instance, there may be another Cyber-I for working among original architecture, and one Super Agent named "Super-Agent for Device Usage" between Cyber-I for Learning and underlayer agents can be added specifically for the management of device usage.

A specific log identifies to a single aspect of an individual in cyber space such as G-Logs for Gaming and L-Logs for Learning. With these logs, Cyber-I can be utilized to describe an individual in a multifaceted way. And, also, because of the existence in the cyber world, Cyber-I can advantage from the available spaces, i.e. memory and/or disk, to achieve what an individual may not do by himself/herself in the real world. For instance, all of the information related to individual can be collected and refreshed immediately and be stored in cyberspace. The information is also supposed to be never forgotten. With the support of Internet and peer computing technologies, Cyber-I is considered to have ability of retrieving information and processing them in an efficient way and/or in an well-organization to meet individual's needs, and, also, makes it possible for knowledge/experience sharing among Cyber-Is. Furthermore, since the experience can be shared in cyber space, Cyber-I can provide necessary information corresponding to individual's needs proactively.

With the support of Cyber-I, the connection between agents, especially those made for same purposes, becomes close. The information/experience sharing is also available between agents. And with the advantages of cyber space, Cyber-I can also work concurrently and the experience stored in it can also be ageless. In another word, we can outline an individual comprehensively through his/her exclusive Cyber-I.

IV. REEXAMINING UPS AND HARDSCORM FROM THE PERSPECTIVE OF CYBER-I

As stated, the huge amount of personal information is essential to construct the Cyber-I. The two concrete achievements, HardSCORM Project and UPS (Ubiquitous Personal Study), will be discussed in this section. The concept, Cyber-Me and Cyber-Mine, extended from Cyber-I will also be lead by these achievements.

A. HardSCORM in the Context of Cyber-I

The HardSCORM Project [8] is a way to achieve personal learning by using different terminal devices, such as PC, cell phone and laptop/tablet, in a ubiquitous environment. In this project, we have developed three major learning related systems: an authoring tool for creating learning content, a LMS (Learning Management System) for interacting with learners, and a repository for managing resources. Learners can make use of different devices to access the LMS for retrieving adaptive learning resources, both content and metadata, created by instructors through the authoring tool. A metadata is used for describing specific learning resource. It will be referred by learners' profiles to decide what kinds of resources shall be delivered to them. Based on the concept of Cyber-I, we can scale the learning environment down to focus on the different usage of devices. The HardSCORM in the context of Cyber-I can be outlined as Figure 2.

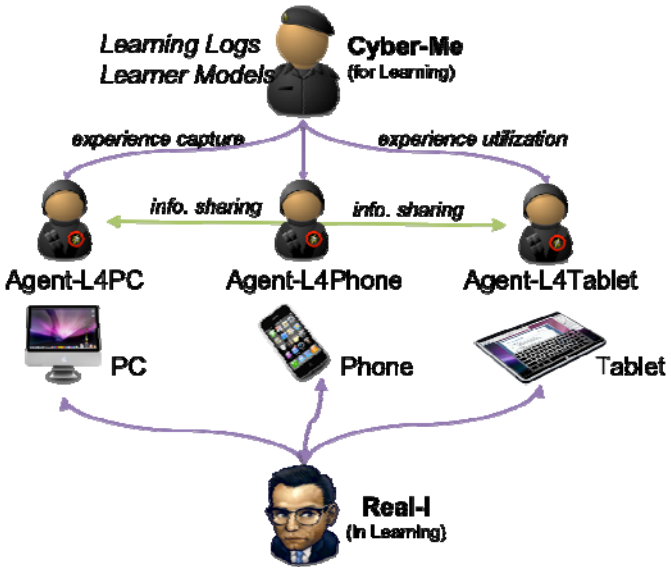
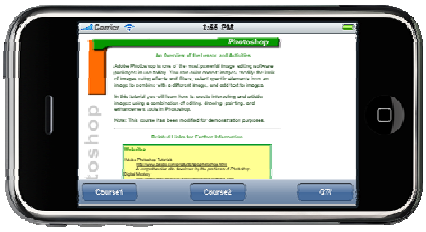


Figure 2. Learning Scenario in HardSCORM Project

In Figure 2, the term "Agent" is used to represent the automatically usage experiences processing, especially those between devices, for setting up adaptive learning environment for learners. It is a little bit difference between the one used in Agent System [23]. We mainly borrow the concept of it and extend its meaning to indicate a virtual individual who assists the real individual in using his/her past experiences in the cyber space. The behaviors may be similar while utilizing different devices. In this project, learners are thought to make use of three kinds of devices to access the learning content. However, it is obvious that the learning content shall be adaptive to the corresponding devices. Once when learners utilize a specific device, i.e. PC, to retrieve the learning content. The usage behaviors, as part of learner profile, will be recorded in a general format described in [1]. We take the recorded information as a kind of usage experience. This experience can be shared between different agents. Once when an agent developed for assisting an individual in using other devices, it can take the existing experience, i.e. from Agent-L4PC, to be the basis of generating fundamental logs. Thus, the system will not need to collect the information from the beginning. And, also, all the experience from agents will be synchronized to the higher layer "Cyber-Me" which is considered as the one who can represent an individual in learning aspect in cyber world.

(a)



(b)

Figure 3. Implementation of HardSCORM Project

Figure 3(a) shows the implementation of the results learners is accessing the learning content with their desktop. All the information will be displayed on the screen. Learner can choose what they may need through mouse clicking on the specific position, and the corresponding information will be appeared. The operating behaviors, such as the preference browsing types and the numbers of external links learner clicked, will be recorded. In this example, we removed the content cluster in the left side of Figure 3(a) and leave all the external links, including those to websites and to multimedia recourses, since the learner can access such kinds of resources on this portable device as shown in Figure 3(b).

B. UPS in the Context of Cyber-I

Followed by the implementation of HardSCORM Project, the concept of UPS [15] is proposed for virtual learning environment that includes learning information retrieval, organization, and recommendation by integrating ubiquitous computing and Web 2.0. In this environment, the way to manage and share the learning experience and knowledge will be taught to learners. The UPS includes the learners' profile, personal activities, and the interactivities between learners. We make use of the technologies of Web 2.0 and make personal data digitalization in this environment. We aim at supporting accessing, managing, organizing, and sharing the personal information.

Two major services, Personal Information Collection and Private Information Behaviors, are developed in UPS. The first one includes V-Bookshelf and V-Desktop utilized to collect the related information while learning activity is proceeding. Learners can make use of the functionalities, V-Book and V-Note, to manage their personal learning information. The other one includes the learners' private services like V-Card and V-Log, used to record all the learning related histories. The essential information mentioned above will be recorded in corresponding services. And the information can be shared between specific learner's UPS, that is, other services can also referred the existing information to be the factors for personal service provision. The general scenario in the context of Cyber-I can be illustrated in the following figure.

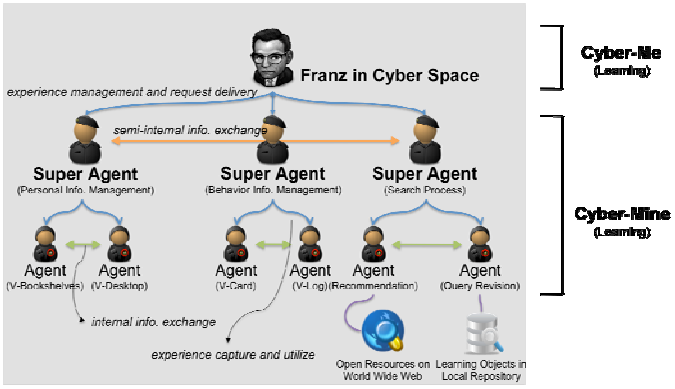
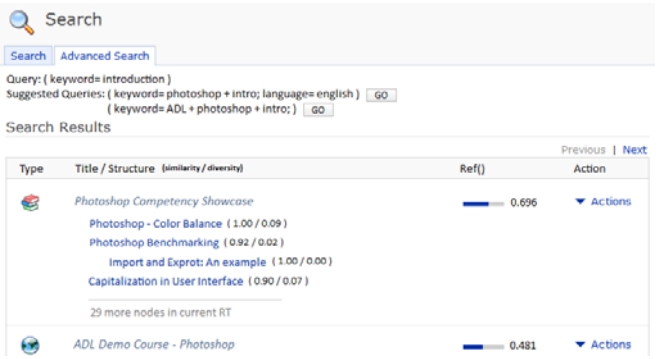


Figure 4. Scenario for Learning in UPS (Tentative)

In Figure 4, the UPS followed the concept of Cyber-I can be separated into two main parts: Cyber-Me and Cyber-Mine. Cyber-Me is supposed to be a single aspect of human being. And Cyber-Mine contains the possible architecture for achieving the specific purpose. In this instance, Cyber-Mine is separated into two layers: Super Agent and Agent. In the lowest level, the Agents are utilized to achieve specific things like to manage the note that may be made while utilizing the V-Desktop. The usage information will be collected and synchronized to its upper level named Super Agent. In UPS, the Agent serves as Instance, the same as one in programming language, which will have direct interactions with learners. And, the Super Agent can be regarded as a Class responsible for a specific process while doing learning activities. The information can be directly accessed with each other among Agents. For instance, the information learner wrote down on the V-Desktop, i.e. through V-Note, may be extracted to be factors, such as keyword or preference type, for possible book provisions in V-Bookshelves. After synchronizing with Agents, Super Agent can also share the information for specific purpose with each other. For instance, the information inside V-Note can also be utilized to revise the direction while performing the search process.



(a)

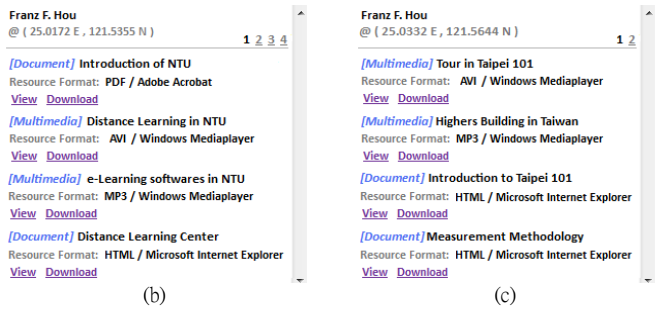


Figure 5. Search Service for Recommendation and Query Revision

Figure 5(a) shows the implementation results of our search interface through browser on PC. By detecting package, the system can identify the device for accessing our search service. In this instance, two results were shown. The first one is a learning resource contains several related sub-resources and lots of them are with multimedia content (i.e. audio, video). Also, the system will also provide suggestions to query revision based on the query criteria user input as shown in the middle of this figure. As to the implementation on portable devices, the system will then provide information based on user's current location. That is because system may assume that user is outside the classroom and query for the resources related to his/her current location, meanwhile, the preference operation, preferred learning time and/or preferred learning type, in profile will also affect the results as shown in Figure 5(b) and Figure 5(c).

V. CONCLUSIONS & FUTURE WORKS

In this paper, the concept of Cyber-I, an individual's counterpart on the cyberspace, was proposed to provide a well-being environment for users while doing anything. Specifically, Cyber-I can also be taken as an integration of several agents who can assist users in dealing with different kinds of things such as learning, working, and/or gaming. That means the experience from game playing, i.e. preference to game types or progress to game play, may be referred by other aspects in which users may be involved. Therefore, as a partial contribution/proof to the concept of Cyber-I, two past achievements were reexamined. The concept can be proved by the successful implementation of learning environment. However, the proposed Cyber-I is not supposed to be limited in this scope. The possible implementations on different kinds of aspects will also be discussed in the near future. And thus, the Cyber-I may be more comprehensive to describe a specific user and to be able to provide more appropriate personalization services to him/her.

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