Visualization of Social Knowledge Awareness Map for Computer Supported Ubiquitous Learning

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Abstract: This paper introduces a social knowledge awareness map in a ubiquitous computing environment in order to support the learners while doing tasks. The exploration of social networks is essential for finding capable cooperators, who can help to solve problems. This system allows the learner to find a peer helper, share knowledge, interact, collaborate, and exchange individual experiences. This paper proposes Knowledge Awareness (KA) map which visualizes the learners surrounding environmental objects, peer helpers and strength of relation in a social network perspective. In this paper KA map is dynamically designed and displayed for every individual learner.

Keywords: Ubiquitous computing, RFID, PDA, social interaction, knowledge awareness map, peer helper, mediator.

Introduction

The word ubiquitous can be defined as existing or being everywhere at the same time, constantly encountered, and widespread. When applying this concept to technology, the term ubiquitous implies that technology is everywhere and we can use it all the time. Ubiquitous technology is often wireless, mobile, and networked; making users more connected to the world around them and the people in it. One of the most important ubiquitous technologies is RFID (radio frequency identification) tag. RFID can be used to tag objects around learners instead of barcode and to detect the user’s context [1]. There are two types of educational applications are available using RFID tag. One is to detect object, person and another is to detect person location [2].

Ubiquitous computing technology helps to organize and medicate social interaction wherever and whenever these situations might occur [3]. Computing become ubiquitous [4]. The challenge of the computer system is therefore not only to provide information at any time and any where but also to provide the right thing in the right way to the right person at the right time [5] [14]. Communication systems in ubiquitous computing can be many to many, one to one or one to many. The main characteristics of ubiquitous learning are shown as follows [11] [12] [13]:

1. Permanency: Learners can never lose their work unless it is purposefully deleted. In addition, all the learning processes are recorded continuously everyday.
2. Accessibility: Learners have access to their documents data or video from anywhere. That information is provided based on their requests. Therefore, the learning is self-directed.

3. Immediacy: Wherever learners are, they can get any information immediately. Thus, learners can solve problems quickly. Conversely, the learners can record the questions and look for the answers later.

4. Interactivity: Learners can interact with experts, teachers or peers in the form of synchronous or asynchronous communication. Hence, the experts are more reachable and the knowledge is more available.

5. Situating of instructional activities: Learning could be embedded in our daily life. The problems encountered as well as the knowledge required are all presented in the nature and authentic forms. It helps learners notice the features of problem situation that make particular actions relevant.

6. Adaptability: learners can get the right information at the right place in the right time.

Computer supported ubiquitous learning environment includes computer supported collaborative learning (CSCL) environment [6]. But the problem in collaborative learning system is to know in the beginning that the other learners may also have the same knowledge he is looking for.

There are two logical ways to get the desired knowledge. One way is to refer to one or more educational materials that match with the learners need like books, journals or video lecturers. And the other way is to ask for help from another learner who have enough knowledge about the learner’s request [4]. In the second case the learner can interact and solve his problem if he aware of other learners and their knowledge.

This paper differs from its previous studies [4] [7] in the social network perspective view. The proposed system can recognize the students and the environmental objects around a learner. It uses RFID tag to detect other students and environmental objects. This system matches between other learner’s education materials and learner’s current tasks, and then recommend peer helpers. PHelpS (Peer helper System) [7] described a peer helper system but doesn’t provide the environmental object map. In this paper, Peer helper recommendation is based on level of similarity between their knowledge of interests and frequency of meeting. PERKAM [4] suggested two different maps to support a learner based on best matched educational materials and peer helpers in accordance with the detected objects and the current location. In our research Mediator concept [8] is introduced. A learner also can get help from an unknown expert introduced by a mediator who is a friend of both learner and expert. Instead of two different maps the proposed system merged the object map and peer helper map into a single one. The KA map in our system can also visualize the strength of recommended peer helper. The section 1 in this paper describes how to aware of other person and their knowledge. In section 2, a scenario about this system is given. How this system works is shown in section 3. System architecture is given in section 4. And in section 5, conclusion and future work is described.

1. Awareness about others

In a collaborative learning environment, it is difficult for a learner to find other learner’s knowledge because the learner might not understand their actions in the remote site beyond Internet. In this paper, some methods are proposed in section 3.2 to notify the learner about other learner’s experience. Knowledge awareness map has been proposed to
connect learners, who are interested in the same knowledge and to create effective collaboration in a distinct learning environment [9]. In order to induce collaborative learning, this paper prepossessed a social KA map that visualizes the KA information with social relationship. The social knowledge awareness map is personalized according to the learner’s need and relationship.

1.1 Learner space

Learner space awareness concerns about other learners and their knowledge of interest in a learning environment.

It is considered that every student carries one PDA, RFID reader and a tag which is attached to the student’s ID card. Figure 1 is a schematic drawing of this process. PDA is connected to the Internet through wireless network. When they meet each other they can ask their knowledge of interest and read the tag. If all task finished successfully, these information will update automatically to system database. In this way, a learner may know who is more familiar and who have which knowledge. A student requires up to minute knowledge about other students’ interactions and proclaims that such information plays an “integral part in how well an environment creates opportunities for collaborative learning” [10].

2. System Usage

Considering a case, a learner in a chemistry lab is trying to make Phosphate Buffered Saline (PBS). He has no idea about the exact amount of the reagents (such as Sodium Chloride, Potassium Chloride, Potassium Phosphate and Sodium Phosphate) use for PBS. RFID tag is attached with each reagents bottle. Learner can read the tag of reagents that surround him by RFID reader. After that he can use this system to build a KA map where all reagents that learners use in his system and peer helpers appear dynamically. KA map provide information about helper’s knowledge of interest to a learner. In KA map learner will get the images of peer helpers. Peer helpers recommendation methods are similarity of between their interests, most interacted person, and with the help of a mediator. When the learner moves the cursor over an image of a peer helper in KA map; helpers name, room number, email address, and phone number will be shown in a text box. After that, learner can choose a peer helper from the system recommended peer helpers. From KA map helper also can get information about the reagents that the learner wants to use in his experiment and understand the problem easily. Then system recommended helper can send message to the student about the amount of reagents using this system. After that they can discuss about their problem if needed. Furthermore, if the system recommended peer helper is unknown to a learner, he may reach to that peer through mediators. So, by
the help of this system the student can easily discover who have knowledge for which learner is looking and the problem of a learner can be easily solved by this system.

3. How does this system work

Knowledge awareness map is personalized according to learner’s need and social relationship. This system can recognize and visualize the environmental objects around the learner. The system matches current learner’s need and other learner’s interest (i.e., keyword matching), check the value of frequency of interaction and recommend the best four peer helpers. The learner can contact with one or more peer helpers to solve his problem.

Figure 2. How does the system work?

3.1 Knowledge Awareness (KA) map

Knowledge Awareness map consists of two parts: environmental objects and peer helpers as shown in figure 3.

Environmental objects are the objects, that learner uses during his practical study. It may be computer parts, chemicals, cooking materials etc. Each object has its own keywords that notify its specification. One object may share one or more key words with one or more other objects. Each object is represented by a photo. To know details about an object when a learner move mouse pointer over an image all details will be shown in a text box down to the KA map as represented in figure 4. From KA map, peer helper can easily understand the learner’s problem.

Figure 3. KA map Figure 4. HW details Figure 5. Peer details Figure 6. Mediator
While a learner interacts with other learner remotely, it may be difficult or need long time to describe exactly the available objects that he is going to use during his practice. But KA map makes this task easy for a peer helper. Furthermore, this map can display the knowledge space of recommended learners, who are using the same system and have enough knowledge about the learner’s need. From KA map learner can easily recognize peer helpers. To know details about a peer when a learner move mouse pointer over an image of a peer the name, room number, email address and telephone number will be shown in a text box down to the KA map. This map also represents peer helper’s Knowledge of interest. Figure 5 represents contact address of peer helper as well as the knowledge he has.

The link in this map represents the strength of relation. If the color is dark for a particular peer that peer is recommended highly by the system. Faint colored link represents weak recommendation. Moreover, if the learner presses over the peer with a faint colored link, a mediator will appear as shown in figure 6. Through that mediator learner can reach to the peer. Hence, it is possible for a learner to know about all peers and mediators from this system. By clicking on learner’s icon in KA map, all mediators will appear. In case the map is complicated enough, learner can disable the mediator by clicking on mediator’s icon.

3.2 Peer Helpers recommendation methods

This map recommends best four peer helpers depend on three criteria. These are

- Similarity of their interest.
- Frequency of meeting
- Through a mediator.

3.2.1 Similarity of interest

This map displays recommended helpers who are using the system and have enough knowledge about the learner’s request. The level of recommendation of each learner appears based on his interests. Consider that L is a certain learner, n is the number of keywords that a learner’s request consists of, and nL is the number of the matched keywords with a certain learner’s interests. In this system the Level Of Interest (LOI) is calculated as follows:

\[
\text{LOI} = \frac{n - n_L}{N} \quad \text{Where } 0 \leq \text{LOI} \leq 1
\]

When the LOI value becomes equal or close to zero, then L will be recommended as a peer helper.

3.2.2 Frequency of meeting

When learners meet each other they updated the number of meeting by tagging students with RFID reader. Consider that ni is the number of interaction with learner and N is the total number of interaction. Each time learners met, the value of ni will increase. Frequency of meeting is calculated as follows.

\[
P_i = \frac{n_i}{N}
\]

Figure 7. Learner interaction
The most interacted person can be found by the highest value of P. For example, in figure 7 if a student interact with L₁, L₂ and L₃ 3, 2 and 1 times respectively, then the most interacted person with learner can be found

\[
P₁ = \frac{3}{6} = 0.5 \\
P₂ = \frac{2}{6} = 0.3 \\
P₃ = \frac{1}{6} = 0.1
\]

So P₁ is the most interacted person with learner and will be recommended by the system.

3.2.3 Through a mediator

If the value of level of interest (LOI) is equal or close to zero and number of interaction is high for a peer, then that peer will be recommended highly by this system.

But in case of LOI value is equal or close to zero and number of interaction is also zero, the system recommend mediator for that peer. This mediator is a friend of both peer and learner. And the learner can reach to an unknown peer helper through mediator (figure 8).

4. Software Prototype

This system is developed using Macromedia Flash Action Script. Knowledge awareness map is dynamically designed here.

4.1 User Interface

Every student has a PDA connected to the network. Each PDA has a RF reader. RFID tag is attached with every student and every object. With the RFID tag students and objects can be identified using RFID reader.

When a learner faces any problem while doing task, s/he can detect all environmental objects using in his/her study. By using this system he can generate KA map. The knowledge awareness map represents each object by a small photo of the same object type in order to let it easy for the learner to understand and recognize the physical objects.
When the learner moves the pointer over a certain objects, all the object details will be illustrated in the text box under the KA map. Using this ka map learner can know about peer helpers. This system recommend peer helpers based on similarity of interests (LOI value), which can be found from key word of objects, and number of interaction value (P value), which can be found by tagging students. In knowledge awareness map learner get the photo of helper, name, phone number and email address. Then the learner can interact and collaborate in order to finish his task successfully.

4.2 System Configuration

This system consists of the following modules (as shown in figure 9):
Learner model: It contains the learner’s profile. Learner profile consist of
- Personal data (such as name, age, gender etc.).
- Learner past actions.
- Learner interests.
Object model: It contains information about the environmental objects the may be used by the learner.
Message system: It provides the learner with an easy tool to exchange messages with the other learners.
Social relational manager: It detects other learners and teacher who is surround learner.
Object manager: It detects the objects that surround the learner.
Search engine: It matches between the learner’s request and the other learners’ interests and recommend the best four peer helpers.
Map generator: It presents the surrounding environmental objects and the recommended peer learners according to the learner’s need.

Figure 9: System Architecture
Map visualization: It prepares the enough information to graphically visualize the KA maps.

5. Conclusion and Future Work

In this research, a social knowledge awareness map in a ubiquitous learning environment is designed. A proposal is given here how to recommend a suitable partner at the beginning of the collaboration. Social knowledge awareness map has been proposed here that supports learner to find the best four peer helpers for his problem solving in an open ended collaborative learning environment. This social knowledge awareness map can visualizes the environmental objects, peer helper, and strength of relation with a peer. It helps learner by recommending peer helpers according to their similarity of interest and frequency of meeting. The suggested map can be applied to science learning, cooking, fishing, chemical experimentation and car maintenance area.

In the future the evaluation of this system will be continued. The evaluation will investigate the impact of this system based on a survey involving students in the future. In future, the present system can be used to any field where RFID tag is attached with objects. The goal of this system is to find a solution when students face any problem while doing task by providing peer helpers.

References