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Passive Capture for Ubiquitous Learning Log Using SenseCam

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Abstract: In our previous works, we developed a system named SCROLL in order to log, organize, recall and evaluate the learning log. However up to now, we just use an active mode to record logs. This means that a learner must take a capture of learned contents consciously and most of learning chances be lost unconsciously. In order to solve this problem, we started a project named PACALL (Passive Capture for Learning Log) in order to have a passive capture using SenseCam. With the help of SenseCam, learner's activity can be captured as a series of images. We also developed a system to help a learner find the important images by analyzing sensor data and images processing technology. Finally, the selected images will be uploaded to the current SCROLL system as ubiquitous learning logs. This research suggests that SenseCam can be used to do passive capture of learning experiences and workload of reflection can be reduced by analyzing sensor data of SenseCam.

Keywords: passive capture, learning log, life log, sensor data, SenseCam, ubiquitous learning

Introduction

Learning Log was originally designed for children as a personalized learning resource [5]. It was set by teachers to help their students record their thinking and learning. In this learning log, the logs were usually visually written notes of learning journals. Since 2009, we started our project named Ubiquitous Learning Log supported by PRESTO (Sakigake) JST (Japan Science and Technology Agency) [8]. We defined a ubiquitous learning log as a digital record of what a learner has learned in the daily life using ubiquitous technologies and proposed the SCROLL (System for Capturing and Reminding Of Learning Log) [7] to help learners collect their learning experiences as ubiquitous learning objects (ULLOs). However, currently ULLOs are created by learners manually. Learners must record their learning experiences in the form of photo, video or other formats consciously. It is evident that learners cannot record all of the learning experiences in the system and most of them will be lost and forgotten.

In order to solve this problem, we attempt to introduce the concept of life log into this system. The notion of life log can be tracked back at least 60 years [1]. It means to capture a person's entire life or large portions of life. It usually uses digital devices to record life log such as wearable cameras or video recorders. However, if there is any way that we can extract the learning part from it, the learning log will be more significant and more sufficient. Besides, our system captures the learning log beyond their consciousness and learners' burden will also be reduced.

In this research, we use SenseCam to have a passive capture. SenseCam is a prototype device under the development of Microsoft Research [4]. It is a small digital camera that is

combined with a number of sensors to help to capture a series of images of the wearer's whole daily life at the proper time and it can be worn around the neck. Actually this device is designed for memory aid. The SenseCam itself has an algorithm for capturing images by a time trigger and other triggers that use sensor data. However, because SenseCam is designed for memory aid, it takes photos continuously even if it is dark or the situation is not been changed. The result is that there are so many photos that are duplicated or blurred or dark.

1. Related Works

MyLifeBits [6] is a Microsoft's project. The aim of this project is to implement Bush's Memex model [1] that proposed to store everything that you saw and you heard. MyLifeBits has a large amount of storage that can store email messages, web pages, books, photos, sounds, videos, etc. In addition, the MyLifeBits project team is also using SenseCam to have the passive capture of life log and upload the sensor information along with the photos to the MyLifeBits repository [3].
Fleck and Fitzpatrick [2] used SensorCam to support collaborative reflection. In their research, the students were asked to wear SenseCam when they played arcade games. After that, they did a reflection on their learning experiences. They found that SenseCam images were not only used to support memory aids but also can be used as resources for supporting the collaborative reflective discussion.

2. Research Design

2.1 Learning Process

The whole process of passive capture happens unconsciously. However it is no doubt that the photo capturing is not the whole process of learning. It is necessary for learners to look through the captured photos and find the learning contents with the help of system. After entering the information of the image such as title and description, this learning content will be saved into SCROLL system as a ULLO. Of course, the saved ULLOs need to be recalled to help learners to remember, but this is the feature of SCROLL. That is to say, a process of passive capture includes capture, reflect and store. Such process is called a PACALL frame. Figure 2.1 shows this model.

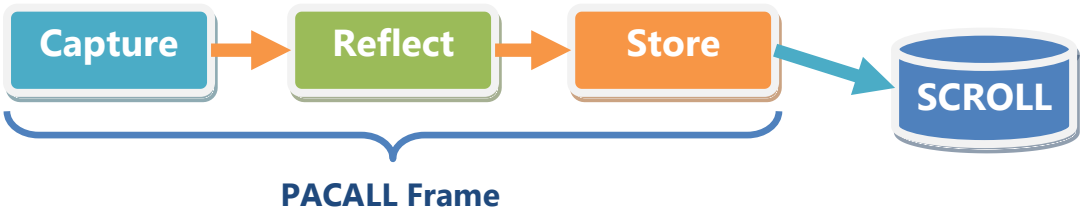

Figure 2.1 Model of Learning Process

2.2 Photo Classification and Sensor Data

In PACALL, we use SenseCam to have a passive capture of learner's daily life. However, since this device takes photos continuously, more than 200 photos will be taken in one hour,

and more than 1500 photos in one day. Therefore, we propose a method to classify these photos by sensor data.
All photos are divided into 5 levels based on importance – manual, normal, duplicate, shake and dark. Manual means the photo is taken by pressing manual button consciously. When a learner takes a photo manually, it means that this photo must be important from his point of view. Normal means the photo is clear and can be used as learning log object. After excluding the duplicates, shake and dark, left photos are judged as normal. Duplicate means the photos are duplicated. Duplicated photos usually have same conditions. Shake means the photo is blurred. It usually happens when the light level is low and the camera shakes. Dark means the photo is taken with insufficient light and the photo is dark.

3. Implementation

3.1 System Architecture

In this research, the SenseCam that we are using is produced by Vicon Revue [9]. When the SenseCam is connected to the computer, if the software Vicon Revue Desktop is already installed, all photos will be imported into computer. The location of SenseCam repository is in the user's document folder and the name is Vicon Revue Data.
This system is programmed using Java and runs in Tomcat as a B/S system. When using this system, Tomcat accesses the repository of SensorCam photos directly and shows them in web browser.

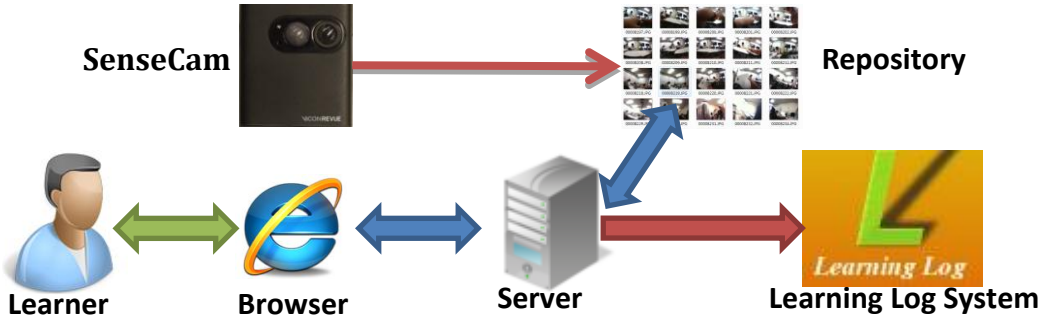

Figure 3.1 System Architecture

Figure 3.1 shows the system architecture. All the photos captured by SenseCam and sensor data are imported into repository. When a learner uses this system through browser, server accesses repository and analyzes the photos by sensor data, then returns the classified photos to learner. Then he selects proper photos and uploads them to learning log system through the server. We have a plan to use image processing technology to detect the photos which contains faces or texts.

3.2 User Interface

Learners need to set the repository of SenseCam and the username and password of Learning Log system when the first run PACALL.
After that, folders will be shown to them including the name of the folder and imported time (Figure 3.2a). Each folder contains photos for a PACALL frame.

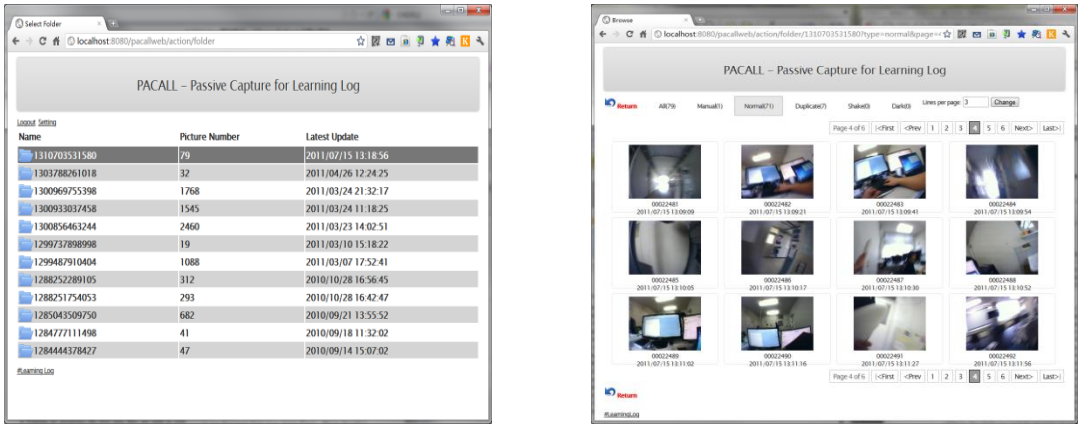

Figure 3.2 Interface of PACALL

On the page of Figure 4.2a, a learner selects a folder. After selecting one folder, the system fetches photos in this folder, and analyzing the sensor data, finally Figure 4.2b will be shown. All photos are classified into five tabs. He can switch between tabs and find proper photos. Finally, the selected photos will be uploaded to SCROLL system.

4. Initial Evaluation

This is an initial evaluation experiment. We have conducted this experiment on computer and the target is to see the effect of analyzing sensor data.
Firstly, we use SenseCam to capture daily life. Then using PACALL to classify the photos and review the accuracy rate. This process has been conducted for three times. Table 4.1shows the result of this experiment.

Table 4.1 Result of Evaluation Experiment

No.	Capture time	Total number	Normal (correct/total)	Duplicate (correct/total)	Shake (correct/total)	Dark (correct/total)
1	2.5h	683	544/579	1/1	26/28	41/73
2	4.8h	1089	377/434	383/383	8/16	166/253
3	24h	2467	46/86	1800/1800	0/5	568/568

No.1 was captured in a common daily life, and no.2 was captured in a conference, and the no.3 was captured when we left SenseCam on the table during 24hrs. From this table, we learned that duplicate has the highest accuracy rate. It means in duplicate tab, all of photos are duplicated. But the results of shake and dark were not sufficient enough. After analyzing data manually, we have noticed that value from color light sensor is not changed immediately upon the light change but photo is usually taken at that time.
On the whole, this system is helpful for reducing the workload enough and usable for reflection. In the future, we will also use image processing technology to improve this system.

5. Conclusion and Future Work

In this paper, we introduced a project named PACALL that supports passive capture for learning log using SenseCam. We have designed a model of learning process in passive capture mode including capture, reflect, store. The PACALL system has been also developed in order to support reflection and reduce the workload of reviewing photos.

During this research, we found that the SenseCam that originally designed for memory aid can be also used to capture learning log for passive mode. However, it usually takes too many photos, and many of them are duplicated or dark. Therefore, we must introduce other technology to help learners find out important photos. Currently, we are using sensor data to help us do it. In the future, we also use images processing technology to detect the contents of photos. Besides, current algorithm and user interface also need improvement. In addition, we plan to conduct a full evaluation experiment and invite students to use this system in the near future.

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