UbiGraphy: A Third-Person Viewpoint Life Log

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Abstract
A traditional life-log is written in the first-person viewpoint since a user collects data using sensors worn on the body. A UbiGraphy that we introduce here is a third-person viewpoint life-log that is made possible by the spontaneous interaction between a wearable computer and smart objects in a ubiquitous computing environment. A wearable computer uses smart objects in the proximity to capture a user's smiles, poses, and even songs from the third-person viewpoint, and then write a life-log where a user appears. This paper presents the design of a protocol that enables UbiGraphy and our first prototyping effort for experiencing UbiGraphy.

Keywords
Third-person viewpoint life-log, life-log, proximal interaction, ubiquitous computing, wearable computer

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
The concept of a life-log, making it possible to trace or assisting individual's everyday life is not a new concept

Figure 1. (a) Photographs captured by myself cannot include my appearance. (b) On the other hand, photographs taken by others can show my life with others.

any more. As the storage capacity of digital devices increases and small light-weight sensors and capturing apparatus are readily available, the life-log concept is being made into a reality by many researchers for varying purposes with different design principles [1, 2, 5, 10]. The primary goal of life-log systems has been to supplement the limited human memory by an almost unlimited digital storage [7, 8, 9]. A life-log may show all the places where we go and all the people that we meet throughout years. A life-log system may create a life-long photo album in details automatically, but the result is a photo album where we never appear. This is the consequence of recording a history from the first-person viewpoint using sensors worn by a user.

In this paper we introduce a third-person viewpoint life-log, that we call UbiGraphy in order to emphasize that it is a life-log concept that is made possible by the spontaneous interaction between a wearable computer and smart objects in a ubiquitous computing environment. For instance, a wearable computer may connect to another wearable computer and take a picture of ourselves from the viewpoint of the person that we talk to. The same concept may be extended to acquiring other types of data such as our interactions with a public device and our steps on an electric treadmill.

Privacy is an important issue that we need to answer in any serious research on a life-log system [3]. It may be pointed out that UbiGraphy may suffer a privacy issue more since it presumes an exchange of personal data between a wearable computer and a ubiquitous computing environment. It is important to realize, however, that it is not a life-logging person's privacy but that of the people around the person that concerns people more. In UbiGraphy, a wearable computer allows nearby objects to acquire its user's own data, and the objects would have been able to acquire the user's data anyway. UbiGraphy would entail no essential change in the level of privacy that can be protected or compromised. It would be more meaningful to compare UbiGraphy with other life-logging systems that rely on a server in a ubiquitous computing environment [4, 10]. UbiGraphy may protect the privacy of users better since it relies only on an anonymous and temporary connection to an individual smart object.

In this paper, we present the first draft design of a protocol between a wearable computer and a smart object that enables UbiGraphy. Also, we describe our first prototyping effort for UbiGraphy experience with three home-made "UbiGraphy-aware" smart objects.

UbiGraphy Scenarios

Some life-log items can be captured better by others than by us. For instance, photos taken by friends or family members may show a moment of our lives more impressively than photos taken by ourselves. (Figure 1) When we meet people, UbiGraphy can create our life-log from their viewpoints. It can take our picture at the moment when we try hard to give a good impression to others. A group activity where many people participate in (e.g., football game, meeting, dinner, concert, etc) can be logged better as UbiGraphy records it from various points of view.

In addition, some useful information about us can be created only by the environment. For instance, a search result by a kiosk computer, a posted message on a bulletin board, a health result analyzed by a toilet, and so on are pieces of information about us but can be better gathered by others around us than by ourselves. We summarize below the scenarios that we collected in a brainstorming meeting in order to illustrate the benefit of UbiGraphy concept.

Scenarios

In the following, the name 'wearable computer' does not only mean a literally wearable computer, but also any computer that is portable enough to be with a user all the time for collecting a life-log.

- A mirror captures smiles and sends them to their owner's wearable computer.
- A roller-coaster post captures surprises and screams and sends them to their owner's wearable computer.
- A mirror in a store captures poses in new jackets and sends them to their owner's wearable computer for their comparison shopping.
- A wearable computer takes notes of what we searched for on a public kiosk computer.
- A wearable computer records the name of songs that we enjoyed in a cafe.
- A wearable computer communicates with items in a restroom to collect our health data.
- An electric treadmill counts our steps and writes it on our UbiGraphy.

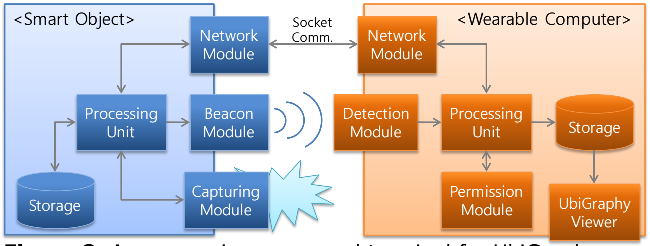

Figure 2. A user carries a personal terminal for UbiGraphy and gathers information from smart objects for UbiGraphy.

UbiGraphy Protocol

In order to realize the UbiGraphy scenarios, it is necessary that a wearable computer can communicate with smart objects that can capture information about users. We explain in the following a protocol between a smart object and a wearable computer that we designed for this purpose.

Component view

As shown in Figure 2, the UbiGraphy protocol is between a smart object and a wearable computer. They communicate with each other through a wireless link.

SMART OBJECT

Any object in a daily life can act as a smart object if it is equipped with additional modules for UbiGraphy: a beacon module, a network module, a capturing module, a processing unit, and a storage unit. A beacon module in a smart object informs nearby users of its existence by emitting a simple beacon signal. In our first prototype, we used an IR signal that can be distinguished from existing remote controller signal patterns. A beacon module can utilize other technologies such as an RFID tag/reader or a location notification by an infrastructure. A user can be notified with the existence of nearby objects only because a beacon signal is usually short ranged and directional. A capturing module captures a user's information such as smiles, poses, searched results, health information, and so on. A network module can use a personal area network: Bluetooth, Zigbee, or WLAN. It is the role of processing unit to communicate with a user, control activation of beacon, and encrypt data before delivery.

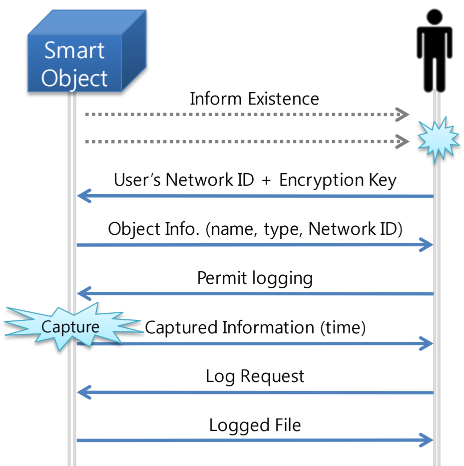

Figure 3. The control flow of the UbiGraphy Protocol

WEARABLE COMPUTER
A wearable computer needs to be equipped with some additional module to enable UbiGraphy. In addition to a processing unit, a storage unit, and a network module, it needs a smart object detection module and a life-log viewer application. When a detection module finds a beacon signal from an object, the device tries to establish a connection with the object through a network module. Checking a permission is required to judge whether the type of data that the object is trying to capture is allowed or not by a user.

Functional view
The UbiGraphy protocol consists of the following three phases as shown in Figure 3: a connection setup phase, a logging phase, and a log delivery phase.

CONNECTION SETUP PHASE
The beacon of an object notifies approached wearable computers of its existence periodically. When a wearable computer finds the object, it broadcasts its network ID and an encryption key (a public key). In response to the network ID, the object sends its information including its name, a media type that it can capture, and a network id.

LOGGING PHASE
Based on the object's information, the wearable computer decides whether to allow or disallow data capturing. If the object receives a permission to capture data, capturing is attempted. Each capturing is informed of to the wearable computer with a timestamp. If the object has a connection with a number of users at the same time, a single user's denial for capturing will prevent it from proceeding further.

LOG DELIVERY PHASE
If the wearable computer requests captured data for logging, the object delivers it encrypted with the public key that it received from the user. The wearable computer will decrypt the data with a private key.

Prototyping UbiGraphy
We made three simple smart objects in a laboratory environment that will be described in Table 1. We decided to use WLAN for networking and an IR signal for detecting proximity. We started prototyping with a real wearable computer [6], but changed later to use a UMPC (Samsung Q1).

MIRROR
The mirror consists of two LCD monitors and a half mirror in front of them. Also, a webcam for a capturing module and an IR emitter for a beacon module are located between the LCDs behind the half mirror. The mirror takes a picture of a user when permitted and passes it to the user.

KIOSK
A kiosk computer usage log, such as a screen capture and title texts extracted from web pages, is delivered from a kiosk computer to a user's wearable computer. Because many kiosk applications these days are constructed in HTML, we used the Browser Helper Object (BHO) interface for capturing user activities.

STEP MACHINE
The last smart object is a step machine. We used a proximity sensor to check steps during an exercise and used a UMPC to communicate with a user's wearable computer. A step event awakes the network module of a smart object, and the UbiGraphy protocol starts.

Table 1. The three home-made smart objects for prototyping UbiGraphy

	Mirror	Kiosk	Step machine
Captured information	A photograph	User interaction with a kiosk computer	Exercise amount
Data type	An image file & a text file – a photo and its date & time	An image file & a text file – a resized screen shot, a title/subtitle	A text file – an accumulated step count
Refresh rate	Every 15 seconds	Every page loading	Every minute
Appearance			
UbiGraphy is triggered when …	An IR beacon signal detected	A navigation starts and a proximity sensor signals	An exercise starts (checking steps)

In a prototyping environment with the three smart objects, we could demonstrate successfully that a wearable computer could create a UbiGraphy automatically by interacting spontaneously with the smart objects. Figure 4 presents the recorded activities of the first author of this paper in the prototyping environment. As he entered the laboratory, he looked at himself in the mirror for a while. Then he took a short exercise. While he exercised, he became curious about how many calories correspond to one Joule, so he did a web search on a nearby kiosk to find an answer.

Discussion

We demonstrated the feasibility of the concept of UbiGraphy with a wearable computer and three home-made smart objects. Even for this simple and limited prototyping of UbiGraphy experience, we had to re-think the required protocol several times. We hope to develop the protocol into a practical one that can link ubiquitous mobile devices and smart appliances. First of all, the UbiGraphy protocol should be improved to handle the situation where an object has to interact with many users at the same time. The current design of the UbiGraphy protocol considers multi-user cases minimally, and does not consider every possibilities that may arise when a smart object has to serve multiple users at the same time. Second, a privacy concern due to sharing the same smart objects among people is due more attention. We argued in the introduction that UbiGraphy can protect a user's privacy better than other ubicomp-based life-log systems because a smart object does not require a user's identity and store a user's information only temporarily. However, this argument obviously relies on a user's trust in a smart object which is difficult to assume. Third, it is natural to consider both of the first-person and the third-person viewpoint data sources for a life-log. While no particular technical problem is expected, seamless organization of personal records of two different viewpoints may bring about a new issue.

UbiGraphy is a concept where we extend our senses to the ubiquitous computing environment so that we can see ourselves. The symmetric other half that we will consider next is to use the ubiquitous computing environment as an output device for the playback of a life-log. The same smart objects that helped us write a UbiGraphy may help us play a UbiGraphy back.

Figure 4. An example UbiGraphy: photos taken by the smart mirror, an exercise log, and search results on a kiosk.

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