Towards *Environment Generated Media*: Object-participation-type Weblog in Home Sensor Network

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ABSTRACT

The *environment generated media* (EGM) are defined here as being generated from a massive amount of and/or incomprehensible environmental data by compressing them into averages or representative values and/or by converting them into such user-friendly media as text, figures, charts, and animations. As an application of EGM, an object-participation-type weblog is introduced, where anthropomorphic indoor objects with sensor nodes post weblog entries and comments about what happened to them in a sensor networked environment.

Categories and Subject Descriptors: H.4.m [Information Systems]: INFORMATION SYSTEMS APPLICATIONS Miscellaneous

General Terms: Design

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1. INTRODUCTION

The advances in sensor network systems that continuously produce a massive amount of data from environments cause a data flood that conceals useful pieces of information thus preventing us from noticing them. The use of sensor data from the environment requires us to cope with this data flood. It also requires to "cook" raw data generated from sensors attached to the environment because we cannot comprehend the environmental situation or the events in the environment solely from the raw data. This paper discusses a way of cooking raw sensor data and providing it effectively to users. We can divide users who enjoy the benefits of sensor networks into two types. One type have expert knowledge and deal with data obtained from factory and outdoor sensor networks. The other type have little expert knowledge and use information for daily life produced from a home sensor network. We particularly need to provide cooked data that can be understood by the latter type of user.

Massive amounts of data flood the WWW. We have two general ways to retrieve content from the WWW: *active* methods such as querying web search engines and *semi-passive* methods such as automatically receiving RSS feeds from favorite web sites. With the semi-passive approach, a user who has no clear query can receive a list of information that relates to the user and choose interesting items from the list. In the sensor network world, TinyDB [1] and [2] achieve active sensor data browsing. By using the TinyDB, a user can query a sensor network in an SQL-like language. [2] also presents an active browsing system that permits us to search events in the real world. The system can inform us of what has happened to indoor objects with sensor nodes for a natural language word set as a query. For example, when a user asks 'when drop vase,' the system replies with the time that the vase was dropped by analyzing sensor data obtained from a sensor node attached to the vase. A user who has no clear query, however, cannot enjoy the benefits of a system that collects data in sensor network.

This paper presents a semi-passive sensor data browsing method that is analogous with web content browsing via RSS. To generate content for provision to users, the method extracts useful information from sensor data, compresses the data by calculating their representative values, and then converts them into user-friendly media such as text and graphics. Using the method, this paper introduces new media that is automatically converted from massive amounts of environmental data in a user-friendly format and which is called *Environment Generated Media* (EGM). We also implement an object-participation-type weblog as an application example of EGM. In the application, sensor nodes are attached to various indoor objects including chairs and doors to detect their states and what happened to them. We aim to generate user-friendly and enjoyable media by constructing a technology that permits anthropomorphic objects to post weblog entries about what happened to them. We select the weblog style that allows semi-passive content browsing because users can then choose an interesting entry from an entry list in the RSS feeds produced from the weblog.

2. ENVIRONMENT GENERATED MEDIA

Environment generated media are automatically converted, in a user-friendly format, from raw environmental data that are *huge* and/or *difficult* to understand. A typical example of EGM is weather information obtained from meteorologic sensors in many countries and supplied on an electronic bulletin board. Although the study presented here uses a sensor network to obtain environmental data, a digest of long movies from security camera footage set up in non sensor network environments is also a kind of EGM.

That is, EGM is defined as user-friendly media generated from massive amounts of and/or incomprehensible data by compressing them into averages or representative values and/or by converting them into text, figures, charts, and animations. (By converting environmental data into text, figures, etc., the data are sometimes compressed.) Con-

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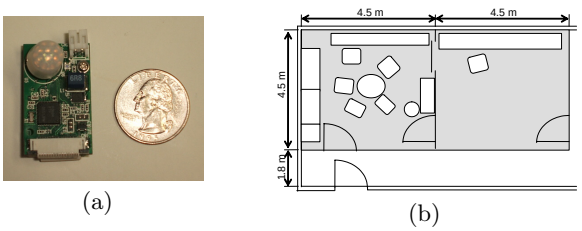

(a) (b)

Figure 1: (a) Sensor node, (b) sensing room.

verting environmental data into figures, charts, and animations facilitates knowledge discovery. The text representation (words, phrases, or sentences in a natural language) of knowledge discovered by a computer also permits us to use it effectively. EGM, implicitly or explicitly, specify such a data source as the location of a sensor producing the data or the type of a physical object if a sensor is attached to the object. Generating EGM enables end-users to access environmental data easily.

In the future when indoor environmental data will be continuously generated, the semi-passive browsing of EGM (or the combined media of a lifelog and EGM) will become a popular way for end-users to browse environmental data.

3. APPLICATION

First, we describe an implementation environment of the weblog application. In the environment, we attached sensor nodes equipped with an accelerometer, a thermometer, and an illuminometer to various objects including chairs, doors, and cups in a sensor networked room. Fig. 1(a) shows the sensor node used in the application. The sensor node collects and sends sensor data to a DB server every 60 milliseconds via wireless communication.

We implemented a sensor network system in an office as illustrated in Fig. 1(b). To enable people to continue working, we included desks, chairs, and a table and installed many kinds of objects such as PCs. We installed four video cameras on the ceiling to record the room. We attached sensor nodes to various items of furniture such as doors, chairs, tables, cups, an alarm clock, books, locker doors, a drawer, and resealable pouches of tea leaves. The personified indoor objects post weblog entries and comments about what happened to them. They post (1) periodically or (2) when events occur. We can classify the events into three types: (2-a) weblog posting by users, (2-b) weblog posting by other objects, and (2-c) occurrence of specific events affecting the objects themselves.

We prepared a total of 34 kinds of services (postings). Some representative examples are:

Door

- If the times when a door is used is different from usual, the door issues a caution. (2-c) ...

Chair

- When a user posts an entry about his/her tiredness, a chair posts the total amount of time during which the user sat on it as a comment to the entry. (2-a)

Cup

- If a cup is dropped, the cup asks with concern whether it has broken or not. (2-a) ...

Locker and drawer

- A locker and a drawer report what objects are in them and post the object lists every week. (1) ...

(a) (b)

Figure 2: Weblog application.

Resealable pouch of tea leaves

- When a user posts an entry about the loss of a pouch, the pouch reports its location and posts it. (2-b) ...

Fig. 2(a) shows a weblog entry, which denotes that a cup was dropped. It includes an animation GIF that was recorded when the cup was dropped. We detect the incident by finding an acceleration data segment where the values of the three axes are approximately zero. Fig. 2(b) shows a weblog entry posted by a user that denotes the loss of a tea pouch and a comment posted by the pouch. The comment includes an estimated location of the pouch and an animation GIF, which was recorded when the pouch last moved before the entry was posted. We infer that objects are in lockers and drawers by using illuminance co-occurrence. When a locker is opened, the illuminance around the objects in the locker increases.

4. CONCLUSION

This paper defined EGM, which are generated by conversion from a massive amount of environmental data. It also presented an object-participation-type weblog as an application example of EGM. As part of our future work, we plan to add various functions that will enable users to create interesting content by collaborating with objects.

5. REFERENCES

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