Measurement of Personal Situation with TPO-sensors

−Application to Recommendation Service−

Kenta SUDO*, Takayuki TOZUKA*, Seiji TATSUTA**, Ryohei SUGIHARA**, Youichi IBA**, Toshikazu KATO*

*Dept of Industrial and Systems Engineering, Chuo University 1-13-27 Kasuga, Bunkyo-ku, Tokyo 112-8551 JAPAN
{k_sudo,kato}@indsys.chuo-u.ac.jp
**Future Creation Laboratory of OLYMPUS CORPORATION 2-3-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo 163-0914 JAPAN

Abstract: The trial which offers the information united from the information of location and time information at the actual location and time of users' is making it carry out in data distribution service now. But, only by taking into consideration the information of location and time, since the interpretation of every user's situation is different, offer of a user's satisfying information is difficult. So, In this study, we attempt to assume the situation of users and introduce it into data distribution services by the combination of the data obtainable from sensors which can view the location and the situation in which users are moving. First, a user's situation was classified into three, " Timing of the acquisition of information ", " Context of users' action ", and " Surroundings ", and the required viewpoint when interpreting a user's situation is proposed. Next, timing is presumed from the interest level to the service currently provided with the user in each situation about offer of information. moreover, in this paper, a user's situation was classified into four patterns of Motionless indoors, Moving indoors, Motionless outdoors and Movement outdoors using GPS and an acceleration sensor two or more TPO-sensors, the data distribution service of the prototype which specialized in "the timing from which a user acquires information" which offers information was made as an experiment, and the evaluation experiment was conducted.

Key words: *situation, timing, information presentation*

1. Background of study

Due to the penetration of cell–phone based mobile devices, no matter when and where, people have been able to acquire information. Further, many companies have begun promoting data distribution services for mobile devices. Recently, such approaches of navigation services have been started, utilizing the GPS built-in to cell-phones.

Such data distribution services have been started in conjunction with appurtenant applications built-in to cell-phones, which make use of data such as the actual location and time of users.

These companies are carrying out their research of data distribution services for the purpose of meeting users' requirements by making use of the applications which are appurtenant to mobile terminals.

We assumed the situation of users from the point of the effective utilization of information of the situation of
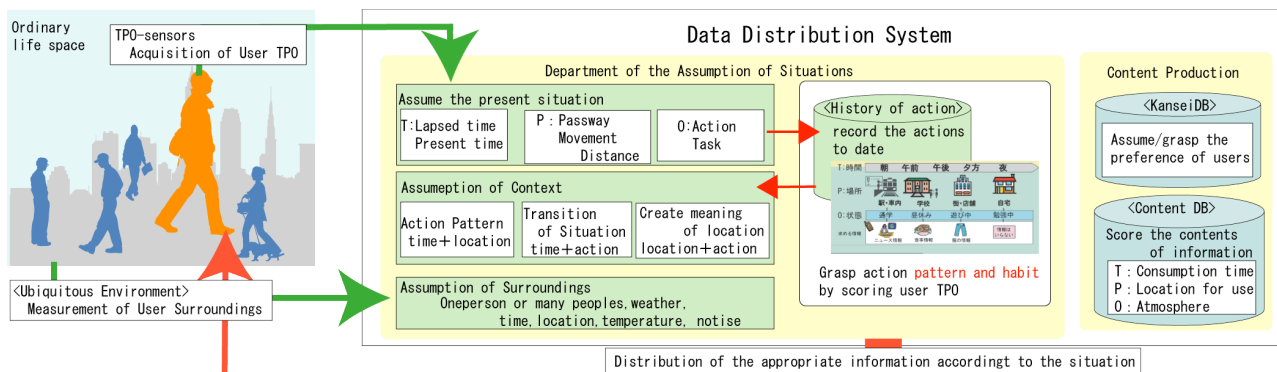

Fig. 1: Example of data distribution services

users, as the method of realizing data distribution services which could meet users' requirements.

In this study, we attempt to assume the situation of users and introduce it into data distribution services by the combination of the data obtainable from sensors which can view the location and the situation in which users are moving (Fig. 1.)

We hope that this study will motivate users to use information in their daily lives and expand their activities.

2. Personal Situation of Users and Need to Assume Situation

2.1 Need to Assume User Situation

Existing data distribution services have functions to refer to such elements as the present situation and time of users, but have no ability of knowing the present situation and required information of users.

For example, when assuming that one user is in Shinjuku at 12:00, several situations may be interpreted, such that "he/she has come for lunch" or "he/she has come for shopping with friends." As it is considered that the user may need different information in each of the above situations, it can be understood that pinpointing the information required by users only with the information of location and time is not possible.

It is absolutely essential to assume the user situation in order to provide such data distribution services, which can satisfy the requirements of users.

Consequently, for the purpose of assuming user situation, we ascertained the elements for users to judge the use of information and assumed that it might lead to the assumption of situation by considering the three points that will follow.

Additionally, "the situation" as it is referred to in this study means the present overall situation of users, themselves, which contains conceptions such as the context of users' action and surroundings which may affect the users.

2.2 Timing of the acquisition of information

In data distribution services, it is inconvenient for users to distribute contents in a situation in which users are unable to access it. It may decrease the possibility of selecting the activities of users, if the contents are not distributed to users in situations where they can't access it. Therefore, the consideration of the timing of the acquisition of information by users may be an important element of the data distribution services,

It is appropriate to discriminate the situation of users at the time of "spot" in order to determine how to judge the timing of the acquisition of information by users. Then, it can be judged by the acquisition of user TPO by use of a wearable sensor. However, when "walking," the required timing is different between the action of "walking" for shopping and that of "walking" to reach a destination.

Actions with a sense of purpose are called "Tasks" (hereinafter called the "Tasks"). It is considered that the timing of the acquisition of information by users can be assumed by assuming the degree of concentration in the Tasks

Further, in this paper, we produced experimental data distribution systems considering the Tasks of users, and conducted evaluation tests.

2.3 Context of users' action

It is essential to understand the users themselves in order to provide data distribution services which can satisfy the requirements of users. This requires understanding the ordinary actions of users. These are the actions users have performed so far (state transition) in usual locations (creating meaning of location) and what actions users may take in the future (action pattern).

These elements for judgment can be identified by making "plural interpretations" of the stored information which has been accumulated by the ordinary actions of users as "history".

The concept of "plural interpretations" of information.

This means that one piece of location information can refer to a wider range of information. For example, the spot of "Shinjuku Station" is taken as "Shinjuku Ward" or as "Tokyo Metropolitan".

Assumption is made by selecting the interpretations suitable for users among these plural interpretations.

It may be considered to be possible to assume the "action pattern" of users from the scored "location" and "time," the "creating meaning of location" of users from scored "location" and "action," and then the "state transition" of one day from scored "time" and "action."

2.4 Surroundings

It is necessary for the assumption of situation to consider the surroundings of users.

For example, the situation may naturally differ between the case of one user only and the case of multiple users. It is also considered that such matters as degree of noise and temperature are useful for the assumption of action which may lead to further steps.

The surroundings of users may be naturally measured by the penetration of ubiquitous environment.

3. Data distribution services by the assumption of tasks

In order to provide data distribution which meets the situation of users, for example, it can be assumed that the information shall not be distributed in situations such as "watching films," "eating a meal," and may be distributed in situations such as "on a break" and "on a train." In this paper, data distribution will be made separately by three steps. These are "3.1 Sensing of the action situation of users." "3.2 Data distribution by the assumption of Tasks of user" and "3.3 Presentation of Information."

3.1 Sensing of the action situation of users

It is necessary to know the movement of users in order to assume the situation /Tasks of users.   Then, we grasp the situation of users and their surroundings by the use of wearable sensors and from the point of ubiquitous environment, and provide the necessary information. However, the ubiquitous environment is difficult to access in our ordinary life and the number of wearable sensors is not so many.

Therefore, this study assumes the situation with adjustable wearable sensors which are measurable and not limited by location.

Such sensors are defined as TPO Sensors which have relatively less load burdens compared to other wearable sensors. These sensors are designated as the wearable sensors which are mainly used in this study,

From the plural TPO sensors, we collect "Location Information," "Time information" and "Action Information" which is taken by users to judge the Tasks of users.

This "Action Information" consists of the plural pieces of sensor information, for example, which can assume Task such as "shopping" and the situations of "moving" "in doors".

3.2 Data distribution by the judgment of user tasks

In the proposed data distribution services, we will pursue the subject with the assumption of the services when users are out on a holiday.

Users have holidays, but they can't use the information outside home.   This situation can be that the users are consciously using the provided services.

For example, when users go to the movies, they are consciously using the provided services of "movies," mainly by their eyesight when they are watching the movies.   However, although they use transport services such as a train when they are moving to the movie theatre, they are consciously using some of the services,

As described above, the situation in which users can access information depends on whether users are responding to the provided services.

Then, of the Tasks of users, we ascertain their degree of concentration from the point of providing services and classify it into the four patterns of "indoors," "outdoors," "motionless" and "moving."

The assumption of the distribution timing of each of the four patterns is regarded as the consideration of users' situations

i) Motionless indoors / Movement outdoors

It may be said that such activities as "on a break," "move to the destination," independently of "motionless/ moving" are not good for users to access the service.

Therefore, the information is actively distributed.

ii) Motionless outdoors

Many situations can be given in which services such as "during dinner" or "movies" are being provided. Therefore, as it may be said that users are time consuming, the information is not distributed.

iii) Moving outdoors

It is in the situation that users are using the services such as "shopping" or "tour of a museum".

But, it may be considered that differently from diet/ movies, the situation changes with reasons such as "tiredness" even when services are being provided

The Tasks of "shopping" or "touring a museum" are considered situated intermediately between Task i) and Task ii).   The information is distributed less frequently than Task i).

Fig.1: Example of Tasks Performed by Users on Holidays

	motionless	moving
indoors	during dinner	shopping
	movies	Visiting a museum
	on a break	moving to a destination
outdoors	on a break	Walking
	waiting	moving to a destination

3.3 Presentation of Information to Users

According to the Tasks judged by the instrument data, appropriate information is provided according to the situation of users.

Such information, which is of no interest for users according to the "Perception Model" that derives the perception of users by mathematical modeling, is excluded from distribution.

As fresh information is always distributed to users, users may actively see the distributed information.

As the medium for the display of information, a constantly wearable small HMD was used for this study.

This equipment is set on the edge of glasses and indicates the transmissive display in the low sight of vision.

As the distributed information can be browsed only by shifting the eye level to the low sight, it is expected that users may browse the distributed information easily.

4. Evaluation examination of situation-adjusted data distribution services

4.1 Full-time wearable small type HMD

The distributed information is displayed in the three categories of "during dinner," "shopping" and "playing" as listed in Fig. 2. It can be selected per category by handling I/O Interface. If one category is selected, three pieces of information are displayed, which are included in the category. By selecting a preferred piece of information, such detailed information can be browsed as shown in the center of Fig. 2. Then, of the information, the evaluation can be made by the four steps of "will go," "may go," "not so much" and "of no interest" as shown in the right of Fig. 2.
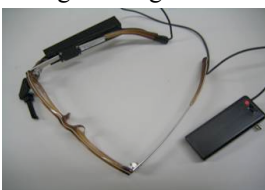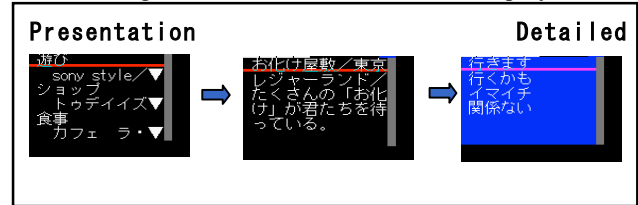

Fig. 2:

Constantly wearable

small type HMD

Fig. 3.Transition of HMD screen display

4.1 Brief overview of the distribution system

GPS can take the three categories of data, i.e. latitude, longitude and speed. In this study, GPS is used mainly for the judgment of indoors and outdoors. The acceleration sensor is used for the judgment of the moving situation of users.

The data recorded by the acceleration sensor is processed and output as "motionless='0' walking='1'、fast walking='2'. These outputs are used for the moving situation of users.

As the result of the accuracy experiment of the equipment for use, the acquisition ratio of data is approx.80% outdoors and approx. 20% indoors. This is due to the blocking by buildings that makes it difficult to acquire data outdoors but makes it possible to acquire data indoors near a window. The data of motionless/ moving were obtained at the rate of approx.100% by the acceleration sensor.

Other equipment is used such as an I/O Interface for handling the display contents of the small HMD, mobile PC for storing/ processing the data from the TPO Sensor and the large-capacity laptop battery.

The data distribution system used in this study provides information and collects instrument data in the following way.

The data from the TPO Sensor are stored in synchronization with the system time of a laptop at regular time intervals. At the same time, the handling of the HMD I/O Interface is stored point by point in a laptop as data. Therefore, from the stored data, it can extract the details of when and where the said information was used.

4.3 Experiment details

This experiment examines the serviceability of situation-adjusted data distribution services. The experiment procedure was as follows

First, we classified the four patterns of indoors, outdoors, motionless and moving of the situation of the time of the distribution of information, and examined it

from the ratio of the overall evaluation of information.

Second, we classified the examinees into Group A, which used the situation-adjusted data distribution services; and Group B, which distributed information at regular time intervals.

The examination was made by the comparison of the overall evaluation of the distributed information of both groups.

Additionally, as such data as "during dinner" was not able to be processed by the system used in this study, the examinees were asked to write down all of their actions and spent time during experiment.

Examination was made by way of summing-up the distributed information by action, based on the information noted in the memorandums. Then, the relationship is examined between the Tasks and the distributed information.

For the performance of the examination experiment, the gross of 50 examinees wore the various equipments as described in Section 4.1 and spent their holiday around Odaiba, where the laboratory was located.

5. Evaluation of TPO-adjusted data distribution

5.1 Evaluation from data utilization ratio by action situation

Of the utilization ratio of distributed information, we classified it into the four categories of indoors, outdoors, motionless and moving. Fig. 4 shows the result.

Fig. 4:User utilizataon ratio of distributed information
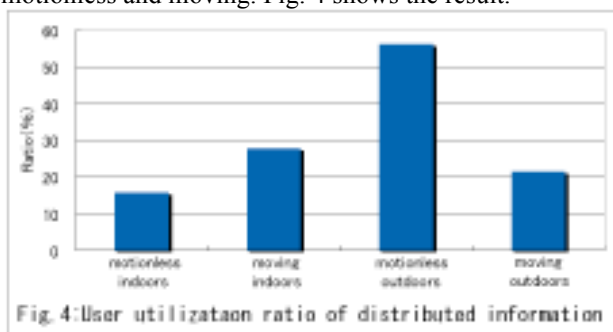
As the ratio is low indoors both for motionless and moving, it may be considered that the assumption as described in Section 3.2 holds true. The Pattern of motionless outdoors shows a relatively high ratio, but the ratio is low for moving outdoors.

In seeking the ratio of moving outdoors for each user, of the examinees with high ratios, nearly 65% used the information. Of the examinees with low ratios, only approx. 5% of them valued the information.

It may be considered that there are great differences between individual users, even if they are in the situation of having a lot of time on their hands when moving outdoors.

5.2 Evaluation from data utilization ratio by task

We summed up the utilization ratio of the distributed information by the Tasks of examinees, based on the memorandums which were noted during the experiment. The result is represented in Fig. 5.

Fig.5:Evaluation from the utilization ratio of distributed information by taskus
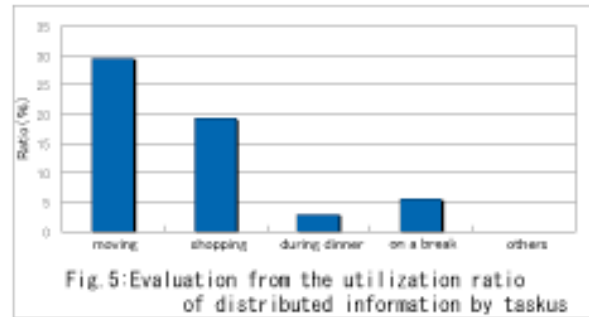
With the result of summing up by Task, the utilization ratio of the information is higher by comparison with other Tasks in the situation that users are not concentrating on Tasks such as during moving.

Meanwhile, in the situation where users are concentrating on a Task such as during dinner, the utilization ratio of the information was lower than other Tasks. We know that "shopping" obtains a relatively high ratio and allows good access to information, but the ratio was unexpectedly low in the situation of "on a break," which was regarded as the time when users were not concentrating on Tasks.

5.3 Evaluation from overall evaluation by users

We summed up the percentage per group of each item of the all of the evaluations regarding the overall evaluation data of the distributed information.

The result is shown in Fig. 6.

Fig.6:Evaluation from overall evaluation by users
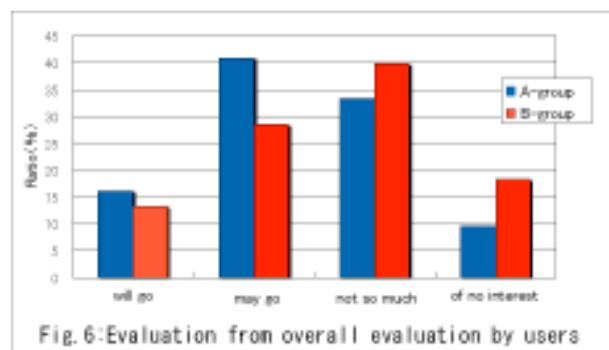
For each item, the two items of "will go" and "may go" represented a positive evaluation of the distributed information and the items of "not so much" and "of no interest" represented a negative evaluation of the distributed information.

From the above, of all the pieces of information, the positive ratio, which totaled the items of "will go" and "may go," was 56.99 % for Group A and 41.84 % for B Group.   The difference was nearly 20%.

This suggests that serviceability can be recognized from the situation-adjusted data distribution services.

Further, considering the situation of the big difference in the item "may go," it may be considered that positive evaluation leads to the promotion of action, as it means that the utilization ratio of information becomes high.

6. Summary and future prospects

We aimed in this study to realize such data distribution services which could satisfy the requirements of users by the consideration of the situation of users

Then, we proposed the assumption methods of the situations of users in the distribution of information, and conducted a demonstration experiment, which distributed information by assuming the timing of the actual situation of users from the degree of concentration on Tasks which performed by users.

As a result, users can be more satisfied with the information by considering their situations, and we can see the possibility that users will expand their action.

However, as the assumption of Task concentration is still vague and there are big differences in concentration on the same Task, it may be said that as data distribution services, the conditions are not satisfied enough to meet the requirements of users.

In the future, we will attempt to raise the degree of user satisfaction of the services by considering the context of users from the stored data.

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