Processing Physical Triggers in Ubiquitous Environment

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1 Introduction

Along with increase in networked devices, we are migrating from one person - one computer to one person - many computers[1]. We asuume that the appliances are heterogeneous, widespread, and finegrained such as wireless tags. In the ubiquitous environment, our concept is to make every object intelligent. Making every object intelligent will allow us to better support the user in his every life. We call services provided by such environment, Invisible Service.

To achieve invisible service, we have proposed Ubiquitous Daemon (UD)[2], which is the platform to keep monitoring every objects. We can provide effective services by employing our proposals. To implement UD, physical triggers of each object are very important to recognize the object's situation and environment and provide effective services. In this paper, we study on processing physical trigger, especially tag-grouping.

Figure 1 shows the concept of UD. Wireless tag is attached to every object to identify itself. Each UD is assigned to each tag uniquely and configured on logical plane. When a tag reader detects a tag, UD corresponding to the tag is activated and determines the effective services. In this way, the UDs keep monitoring the activities and the situations of the objects on the basis of physical triggers.

2 Physical Trigger

UDs recognize the situation and environment by receiving the physical triggers from physical objects such as wireless tags and sensors. The physical triggers should be transferred frequently because the situation of some objects may change frequently. Therefore, the processing method of physical triggers is one of the core technology for UD. Note that, in general, physical triggers are important for ubiquitous computing. We think the contribution of this paper is applicable to other researches.

We assume that the physical triggers are transferred from the widespread and finegrained appliances. The physical triggers are classified into two types;

- Narrow-range trigger
  The triggers transferred from the objects in the narrow zone,
- Wide-range trigger
  The triggers transferred from the widespread objects.

On the other hand, we can also classify the physical triggers in term of the detection time.

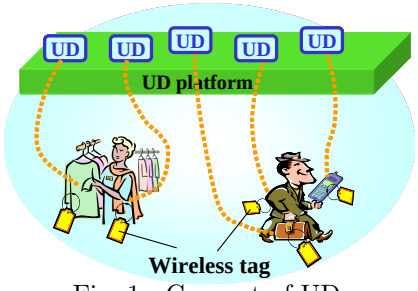

Fig. 1 Concept of UD.

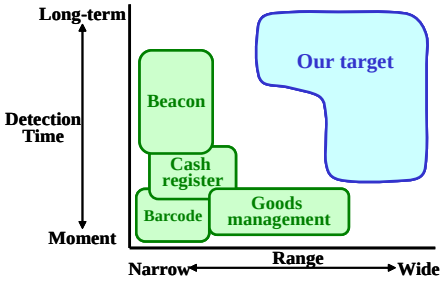

Fig. 2 Classification of physical tigger.

- Momentary trigger
  The triggers detected by a tag reader in a moment,
- Long-term trigger
  The triggers detected by a tag reader which is watching over the long term.

Combination of above two kinds of classification is shown in Figure 2. From this figure, services provided by a few number of the triggers, such as tracking service tend to be positioned to left-hand side of the figure. Services provided by a great number of triggers tend to be positioned to right-hand side of the figure. On the other hand, bottom of the figure tends to show that the triggers are transferred in a moment by request. Upper side of Figure 2 tends to show that the triggers are sent automatically. For instance, barcode is classified into narrow-area and moment trigger in this figure, because barcode reader detects it by request of users one by one.

There are many studies about single trigger, each service is assigned to each trigger uniquely, as shown in left side of Table 1. As long our knowledge, few researchers study about multiple triggers. Therefore, studies about multiple triggers have the potential to provide more attractive services.

3 Grouping Multiple Tags

To implement UD, we assume every object has a wireless tag to identify the object, and physical triggers are transferred from the objects.

Since each UD is uniquely assigned to each object which wireless tag is attached to, when a tag reader

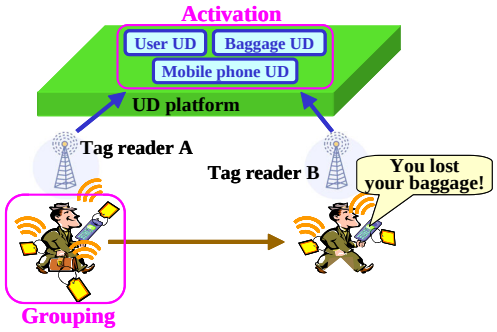

Fig. 3 Example of tag-grouping.

detects multiple tags, multiple UDs can be activated by grouping these tags simultaneously. We call grouping multiple tags, "tag-grouping." The activated UDs determine the effective service by coordinating[2][3].

In Figure 3, we show an example of tag-grouping. When the tag reader A detects three tags, they are grouped and their UDs are activated simultaneously, so that UDs coordinate each other and can recognize that these three goods are carried by one person. Then, if the tag reader B detects only two tags, their UDs coordinate each other and the user will receive the message, "You lost your baggage!"

4 Classification of Tag-grouping

Tag-grouping is very important for the activation of multiple UDs. We can categorize tag-grouping into three types,

- Tag-grouping by fixed tag reader,
- Tag-grouping by moving tag reader,
- Semantic tag-grouping.

Each type has some problems. We explain them in the following section.

4.1 Tag-grouping by fixed tag reader

The problem of tag-grouping by fixed tag reader is attributable to the detection time described in Sec. 2. When multiple tags are detected, the triggers of them must be serialized. Since long-term triggers tend to be transferred automatically, tags detected in a certain period can be grouped.

4.2 Tag-grouping by moving tag reader

Let's assume that users move around with small devices, such as PDA, or cellular phone, which have a built-in tag readers. Since the detection area of tag reader is restricted, multiple tags which are widespread, for instance the all tags in a room, must be detected by the user moving around inside the room with the tag readers. However, the system must recognize which tags are in the same room. This is attributable to the problem of wide-range trigger descirbed in Section 2.

4.3 Semantic tag-grouping

If two users are in a tag reader's area, the triggers of both user's objects are serialized in detecting order. However, we should separate the triggers of one user's objects from those of the other user's objects.

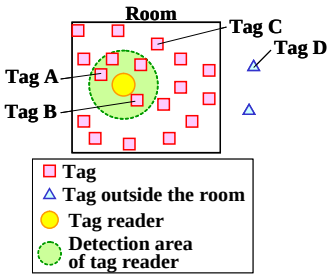

Fig. 4 Grouping tags inside a room.

Table 1 FS table.

	Tag A	Tag B	Tag C	Tag D
Tag A		10	8	0
Tag B	8		7	0
Tag C	10	9		0
Tag D	0	0	0	

5 A Proposal of Solution for Grouping Problem

To solve the problem of semantic tag grouping, we must consider the attribute of objects, which are upper-layer issues. In this paper, we study on lower-layer issues. We think one of the solutions for the problem of tag-grouping by fixed tag reader is storing the triggers in UD platform. Initially, we focus on the problem of tag-grouping by moving tag reader.

The problem of tag-grouping by moving tag readers is how to group the widespread tags. To solve the problem, we define a new parameter, FriendShip (FS) value, which represents the relation between two tags. If two tags are in the same reader's area, their FS value is increased. If not, their FS value is decreased.

In Figure 4, we assume to group all tags only inside room. As the user with the tag reader is moved around, the tag reader detects the tags only inside the room. We create FS table as shown in Table 1, which FS value is described in. From this table, the tags of large FS value are grouped. Since this proposal is one of the solutions, we must study in more detail.

6 Conclusions

In this paper, we have described that the physical triggers are classified and we focus on grouping multiple tags. We have categorized tag-grouping into three types. We have represented one of the solutions of lower-layer issues.

References

[1] Mark Weiser, "The computer for the 21st century," Scientific American, pp.94-104, Sep. 1991.

[2] Kenji Sakamoto, Goro Kunito, and Kenichi Yamazaki, "Toward real-world management platform for invisible services," *Proceedings of the 2002 Communications Society Conference of IEICE*, Vol. 2, SB-4-6, pp.507-508, Sep. 2002.

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