The 3D Shape Information Tags for Recognizing Objects in Real World

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1. Introduction

Tracking objects in real time is one of the most significant challenges in the feild of ubiquitous computing environment. For tracking objects, a system has to continuously obtain the three types of data: position, direction, and shape. At present, there are many practical object tracking systems [1] used in various types of ubiquitous application systems. Most of such systems however have only focused on specifying the position of the objects because it is difficult to obtain these three types of data at the same time. Especially, capturing shapes are harder than obtaining other two data.

To avoid the difficulty, we introduce a method to separate the process of capturing object shapes from the process of obtaining the position and direction of objects. In our proposed method, the 3D shape information data of an object are registered to a database with the ID number of the tag attached to the object before the recognizing process. For tracking the object, the system tries to obtain the position and the ID number of the tag on the object. At the same time, the system reads the shape data corresponded to the ID number from the database. Using both the shape data and the position data of the tag, the system can recognize accurate arrangement (position, direction and shape) of objects. In the rest of this paper, we describe both the proposed method and the prototype tracking system.

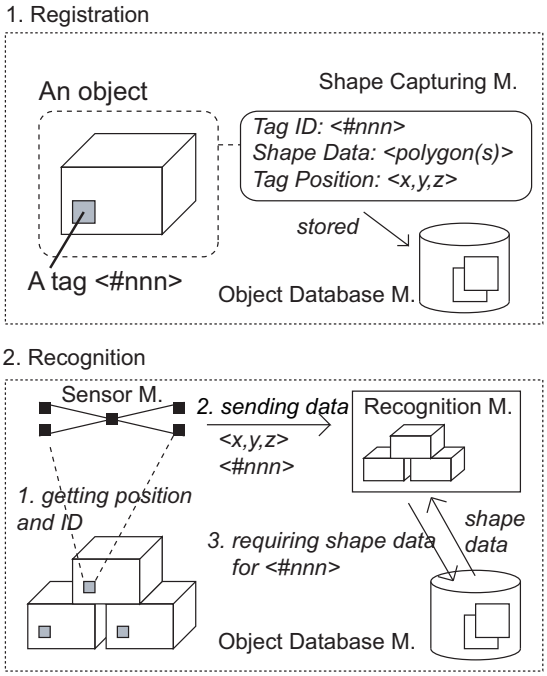

Figure 1: The tag-based tracking system

2. Tag-based Tracking System

Approach As mentioned above, it is in general difficult to obtain simultaneously the shape and position of an object in real time. For tracking object easily, we consider that the shape capturing process should be separated from position obtaining process.

Our proposed tracking system is shown as Figure 1. The tracking system consists of five modules: tags attached to each object, the shape capturing module, the object database module, the sensor module, and the recognition module. The tracking process of our system is composed of two independent sub-processes; the registration process and recognizing process. In the rest of this section, we describe both processes in detail with the explanation of the modules.

Each tag has a unique ID number. At first step in the registration process, the shape capturing module captures the shape data of the object as polygons and the coordinate point $\langle x, y, z\rangle$ of the tag on the object's coordinate system. Moreover, the capturing module registers the polygon data with the ID number attached to the object. The sensor module can specify the coordinate point $\langle x, y, z\rangle$ of a tag and read the ID number from the tag. At the last step in the registration process, both the point and the ID number are sent to the recognition module.

In the recognition process, after the sensor module obtains both the positions and ID numbers of all objects, the module sends the data to the recognition module. The recognition module sends the ID number to the database module for requirement of the shape data related with the number. Then the recognition module estimates the accurate position and direction of an object using the shape data sent from the database. In this manner, even if the accuracy of the positioning sensor is not high enough to be applied to application systems, the recognition module may estimate the accurate position using the shape data.

Prototype System We are implementing a prototype system based on our proposed tracking method. In our system, we use the tags of Spider system produced by RF CODE Inc. The Spider's tag has a wireless communication function to send its own ID number to the sensor module. For improvement of positining accuracy, we also attach a beacon of the INTERSENSE IS-600 positioning system to objects with the Spider's tag. The positioning system can obtain both accurate position and direction (rotation data) of multiple objects at the same time. We use PostgreSQL serving on a Linux PC ss the object database module. The 3D shape data are registered as polygon data stored in the database.

At present, we have no implementation of the capturing module. We will implement it using a 3D laser scanner. In the prototype system, the polygon data are described as text data.

References

[1] N.B. Priyantha, A.K.L. Miu, H. Balakrishnan, and S. Teller. The cricket compass for context-aware mobile applications. In *MOBICOM2001 Conference Proceedings*, pages 1–14, 2001.