

Chapter 9

Gesture Spotting Using Fuzzy Garbage Model and User Adaptation

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ABSTRACT

Thanks to the rapid advancement of human-computer interaction technologies it is becoming easier for the elderly and/or people with disabilities to operate various electrical systems. Operation of home appliances by using a set of predefined hand gestures is an example. However, hand gesture recognition may fail when the predefined command gestures are similar to some ordinary but meaningless behaviors of the user. This paper uses a gesture spotting method to recognize a designated gesture from other similar gestures. A fuzzy garbage model is proposed to provide a variable reference value to determine whether the user's gesture is the command gesture or not. Further, the authors propose two-stage user adaptation to enhance recognition performance: that is, off-line (batch) adaptation for inter-person variation and on-line (incremental) adaptation for intra-person variation. For implementation of the two-stage adaptation method, a genetic algorithm (GA) and the steepest descent method are adopted for each stage. Experimental results were obtained for 5 different users with left and up command gestures.

INTRODUCTION

The shortage of caregivers for the elderly and/or people with disabilities has become a critical social issue in many countries (Kim, 2003; Stefanov, 2004). To cope with the trend, many studies have been conducted on user-friendly

human-computer interaction (HCI) techniques by which the elderly and people with disabilities can operate various electrical systems more easily. A soft remote control system developed at HWRS-ERC in KAIST is an application example of enabling the users to operate home appliances by hand gestures (Do, 2002, 2005). The system

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utilizes ten different predefined hand gestures as a given set of commands as shown in Figure 1.

In spite of these attempts to create a competitive and useful application of hand gestures, the recognition of command gestures is faced with various practical problems: the 3 imperative issues are listed.











- A set of features and decision rules to distinguish command gestures should be carefully obtained through observation of the user’s behaviors. To cope with this requirement, Han (2006) proposed a feature selection method based on a separability index matrix (SIM) and Jeon (2008) constructed a multivariate fuzzy decision tree by using linear discriminant analysis (LDA) and information gain.
- The system needs to be adapted to a specific user to enhance the performance since each person behaves in different way (inter-person variation). In addition, the characteristic of a single user may also change in a different environment. Therefore, an additional adaptation method is required for intra-person variation which occurs for a single user. This adaptation should be executed in real time to modify the temporal difference from a single user.

- In actual operation of the system, it is often observed that some of the user’s ordinary but meaningless behaviors are mistakenly recognized as command gestures. In fact, those command gestures are very likely to be basic natural motions and thus similar motions can appear in the user’s ordinary behaviors. More complicated command gestures may be adopted as an alternative to maximize the different aspects between the command gestures and ordinary motions. Such an approach, however, is prone to decrease the usability of the system and can cause a cognitive burden for the user to memorize the larger set of command gestures.

Given these problems and issues, we introduce a gesture spotting method using the fuzzy garbage model to recognize the designated gesture from the user’s ordinary behaviors, while the existing approach focused on the construction of decision rules with user adaption to achieve high classification performance (Jeon, 2008).

Human gestures observed in ordinary behaviors are likely to be unstructured and occur unconsciously. Moreover, the characteristics of human behavior are different from person to person. It is thus rather difficult to express human gestures by a

Figure 1. Ten different hand gestures

 1	 2	 3	 4	 5
Forward	Backward	Up	Down	Right
 6	 7	 8	 9	 10
Left	Circle in counter-clockwise	Circle in clockwise	Half circle in counter-clockwise	Half circle in clockwise

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