Detecting a User's Request to Record Experience by Analyzing Brainwave Information

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Abstract

The aim of this research is to realize an on-demand system to segment the experience video data of a user's viewpoint. With the on-demand system, users can easily find recordings of their own experiences on-demand. In order to realize the system, we propose a method for detecting the point at which a user wants to record his/her experience by analyzing the user's data measured with brainwave sensor. We confirm the availability of the proposed method for detection by an experiment.

1 Introduction

In this paper, we propose a filter component method to detect the point at which a user wants to record his/her experience by analyzing the data measured with brainwave sensor. We call the point, a "**request point**." Because of the increasing capacity of computer storage, one's lifetime experiences can be recorded in a storage device. On-demand segmentation of the video data is essential for recording one's lifetime experiences, because retrieving a particular scene from a huge amount of video data is a cumbersome task.

Methods for indexing experiences that employ readings from multi-sensors[1][2] have been widely investigated. Most of these methods require rules for indexing experiences e.g., alpha-blocking is observed when a user is excited, and the RR-interval variability decreases when a user feels strained. We believe that these methods for indexing do not always satisfy a user's actual intentions, because the experience a user wants to record has different contexts. The aim of this study is to realize a system with rules that dynamically adjust to a user's intentions.

2 Filter component method

In this study, we assume that multi-channel data measured with a brainwave sensor at a request point implies features caused by a user's own cognition. Based on this assumption, we propose a method such that the implied features are discovered by a **filter** composed of various **filter components** (differential, integral, etc.). We define the best filter for detecting the request point as the filter which can convert the shape of the data at the request point to a shape most similar to the reverse-V (Figure 1). The proposed system detects the request point by applying the best filter to the time-series data, and finding the reverse-V.

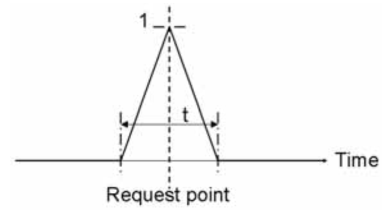

Figure 1: Reverse-V at request point

$Filtercomponents$	$Parameter1$	$Parameter2$
$Non-Conversion$	$-$	$-$
$Absolute$	$-$	$-$
$Reverse$	$-$	$-$
$Multiple$	$multiplier$	$-$
$Power$	$width$	$-$
$Integral$	$width$	$-$
$Differential$	$width$	$-$
$Smooth$	$width$	$-$
$ZeroCrossing$	$width$	$-$
$Delay$	$time$	$-$
$WavySeparation$	$\alpha, \beta, \gamma, \delta$	$-$
$BandPass$	$lowerlimit$	$upperlimit$

Table 1: Filter components

To find the best filter from many combinations of filter components, we employ the Genetic Algorithm (GA) and the Dynamic Time Warping (DTW) method[3]. The DTW method computes the distance between two time-series data with non-liner time normalization. The GA adjusts the order of filter components and the parameters of each filter component, and the DTW method matches the reverse-V with the data applied a filter, and calculates the fitness value of the filter. When the data applied a filter coincides completely with the reverse-V, the fitness value of the

O_1	O_2
$Differential(29)$	$Integral(136)$
$WavySeparation(\alpha)$	$Power(175)$
$ZeroCrossing(175)$	$Power(157)$
$WavySeparation(\gamma)$	$Multiple(111)$
$Absolute$	$Differential(153)$
$WavySeparation(\beta)$	$Power(198)$
$Non-Conversion$	$Power(194)$
$ZeroCrossing(17)$	$Absolute$
$ZeroCrossing(176)$	$Smooth(12)$
$Smooth(8)$	$Absolute$

Table 2: Suboptimum filter

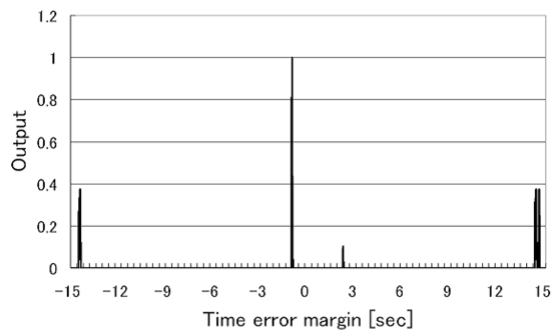

Figure 2: Result of applied suboptimum filter

filter becomes the maximum value 1.

In this paper, we employ twelve filter components (Table 1). Ten filter components are maximally allowed to construct a filter. The variable t in reverse-V is 4 seconds.

3 Experimental Results

The purpose of this experiment is to investigate the possibility that request points can be retrieved by applying the filter component method.

3.1 Experiment

We record the time-series data of a brainwave with 200Hz. We use a 10-20 electrode system, and select 2 measuring points, O_1 and O_2, to monitor the brainwave signals, because the effect on vision is seen from the brainwave signals at O_1 and O_2[4].

A man is selected as a test subject in this experiment. Before the experiment, the subject wears a camera recording his viewpoint images, a brainwave sensor, and a button recording his requests. During the experiment, the subject watches a TV program for about 2 and a half hours while sitting on a chair. The subject pushes the button when he is interested in a scene.

The analysis target is the data measured with a brainwave sensor for thirty seconds, which centers on the time when the subject pushed the button.

3.2 Results

Table 2 shows the suboptimum filters we get in this experiment. In this table, the number in parentheses expresses a parameter of each filter component. The fitness values of the suboptimum filters for O_1/O_2 both became 0.99.

Figure 2 illustrates the graph of the data applied the suboptimum filter. In this figure, the x-axis expresses the time error margin from the time the subject pushed the button, and the y-axis expresses the output of the filter. In this figure, a large reverse-V shape is found near the center.

3.3 Discussions

The result of the experiment shows the possibility that request points can be retrieved by applying the filter component method. In Figure 2, a request point can be retrieved near the time when the subject pushed the button. We consider that the error between the retrieved time and the time the subject pushed the button includes the lag between the time when the subject's request arose and the time when he pushed the button.

Because there are some reverse-Vs excluded when the subject pushed the button, we need to find better filters to make the reverse-V at the only when the subject pushes the button.

4 Concluding Remarks

In this paper, we proposed a method to detect the request point by analyzing the data measured with a brainwave sensor. We confirmed that the proposed method could be realized by the experiment.

We plan to investigate employing the filter with a tree structure for multi-channel data, because of the necessity to analyze the data of different channels together. Therefore, we plan to add filter components for multi-channels data.

Acknowledgement

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