

Poster: Relationship Between LF/HF Value in Heart Rate and Used Mobile Applications

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ABSTRACT

We explore the possibility of detecting person's mood with the usage pattern of mobile applications. Towards this ultimate goal, we first examine the relationship between LF/HF values in heart rate and the CDR (Call Detail Record) logs. Our evaluation result shows that different LF/HF values correspond to different types of mobile applications.

Keywords

Keywords : mobile application, LF/HF, Kolmogorov-Smirnov test

1. INTRODUCTION

In recent years, with the increase of lifestyle-related diseases, interest in mental health has increased. It has become clear that as people continue to feel a great deal of stress for a long time in their daily lives, they modulate autonomic nerves. Therefore, in this study, we explore the relationship between the LF / HF (Low-Frequency / High-Frequency) value, which is one of the autonomic nervous system indicators, and the smartphone application, because the time when the user uses the smartphone in the daily life is increasing. We used COCOLOLO to measure LF / HF values, and smartphone applications were estimated using CDR [1] [2]. As a result of experiment, when KS test (Kolmogorov-Smirnov test) is performed under limited conditions, the equivalence of probability distribution with each application may be rejected, and it became possible to classify, the LF / HF value showed that there was a difference in the type of application used by the user.

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2. RELATED WORK

Anja et al. connected a smartphone which subjectively evaluates acquisition of data of experimenter's mood by questionnaire survey and a smart watch that measured heart rate [3]. Changye and Baobin et al. constructed a model that classifies and predicts health or depression by performing time-frequency analysis such as Discrete Fourier Transform (DFT) on digital records of the Internet [4]. On the other hand, in this paper, we create a system that links the heart rate variability obtained from one smartphone and the usage record of the application, and aim to recognize the stress index from the usage record of the application on the smartphone.

3. EXPERIMENT

3.1 Application

3.1.1 COCOLOLO

It is a smart phone application that can detect changes in RR (R-wave) interval from luminance change of blood flow and measure autonomic nerve index by putting finger on smart phone camera for about 30 seconds. The LF / HF value was calculated from the available LF and HF value which are measured by COCOLOLO.

3.1.2 CDR

Normally, network traffic is logged at telecommunication equipment as CDRs. Traditionally, a CDR was used in telephone calls, but currently, all traffic including WEB access as well. Our method is based on using network traffic recorded by the phone carrier (hereafter referred to as CDR) to estimate what application a user is using.

3.2 Experiment Contents

For one month, we used smart phone that communicates using LTE communication with KDDI line and measured LF / HF value with COCOLOLO. then used the target application. The following five applications are targeted.

(Google search / LINE / Blue mail / Instagram / YouTube)

In this paper, we treat them as Web, LINE, e-mail, Instagram, and YouTube in this order.

3.3 Result

The stress index LF / HF was calculated from the LF and HF values. Furthermore, we created a probability distribution map with the smartphone application estimated from the CDR records and conducted the KS test (Kolmogorov-Smirnov test).

3.3.1 Probability Distribution of each application

The CDR records targeted were COCOLOLO measurement time \pm 10 minutes, and probability distribution was created for each application. The vertical axis is the ratio of usage frequency, and the horizontal axis is the LF / HF value. Figure 1 shows the result.

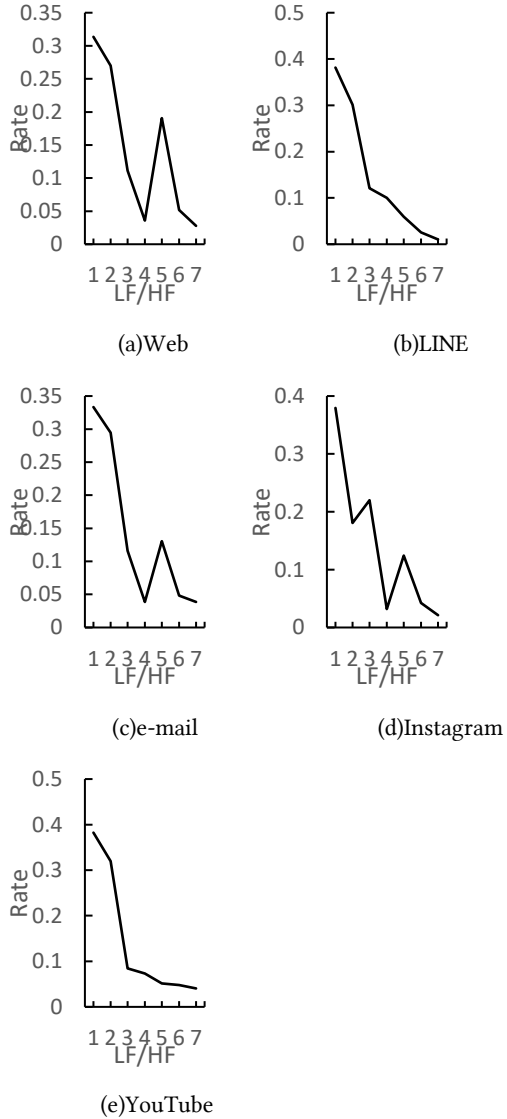


Figure 1. Probability distribution of LF/HF value and usage frequency of each application

3.3.2 KS test

In order to verify whether the two probability distributions are the same or different, 10 combinations of KS tests were conducted. If the significance level is 5% or less, it is rejected and has a different probability distribution. The following table shows the results of the KS test. If it is rejected, 1 otherwise it is 0.

Table 1. The result of KS test

	Web	LINE	e-mail	Instagram	YouTube
Web		0	0	0	1
LINE	0		1	1	0
e-mail	0	1		0	0
Instagram	0	1	0		1
YouTube	1	0	0	1	

4. CONSIDERATION

According to the KS test, the set of Web, e-mail and Instagram was grouped into one category, and the set of Web, e-mail and Instagram and LINE were found to have different probability distributions. Furthermore, when checked against the probability distribution map, the set of Web, e-mail and Instagram tends to be frequently used when the LF / HF value is high, while LINE tends to be frequently used when the LF / HF value is low. Since the subject was one person, it is necessary to recruit subjects with various social backgrounds and to evaluate this experiment. In addition, we will consider the usage time.

5. SUMMARY

In this paper, we measured the LF / HF value using the smartphone application COCOLOLO, estimated the application using CDR, and described the relationship. It is thought that the set of Web, e-mail and Instagram is frequently used when stress index is high, on the other hand, LINE is likely to be used more frequently when stress index is low.

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