DEPARTMENT OF INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Informatics

Detection and Dialog-Based Self-Reporting of Stress for Eating Behavior Prediction

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Erkennen und dialogbasiertes Self-Reporting von Stress zur Vorhersage des Essverhaltens

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I confirm that this master's thesis in informatics is my own work and I have documented all sources and material used.

Munich, 15.05.2020 Wenjian Li

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Abstract

Contents

1 Introduction

Eating is an activity that people perform on a daily basis. It is the essential source of ingredients for us humans. Our nutrition intake, in turn, affects our health. However, people's choice of food cannot be simply regulated in terms of time and ingredients to make the best health effect out of it, because it is a highly emotional behavior (Gardner et al. 2014). According to Gardner et al., both positive and negative moods affect food choices. Especially, having negative moods often leads one to pick indulgent food instead of healthy food to cope with the emotion.

Stress is a common reaction to the environment that is often linked to negative emotions. In fact, Du et al. (2018) suggests that there is a significant positive correlation between the level of stress one has and the degree of negative emotions one experiences. Combining the results from both studies, it is therefore highly likely that food choices could be affected by stress.

A study by Mental Health Foundation (2018) suggests that a majority of the population in the United Kingdom may have been overwhelmed with stress at some time within the year 2018. This suggests that many of the health problems resulted from unhealthy eating behaviors could be linked to stress. However, regulating eating behavior often requires a deep understanding of nutrition and diet, which is not the possession of non-experts. There are professionals who are out there to offer counseling services on people's diet, but this is understandably not always accessible by the general public, given the pervasiveness of stress among them. Moreover, the specific eating behavior resulted from stress differs among individuals (Torres and Nowson 2007). For example, the same level of stress can lead to overeating for one person, but undereating for another. It is, therefore, crucial to work out an individual's eating behavior under the influence of stress without professional medical intervention. This information can be helpful in building food recommendation systems that can detect stress, and recommend healthy food based on the user's eating patterns. The prerequisite of such is to build another (predictive) system so that given a specific user and his/her stress level, it can predict what the user is likely to eat, especially whether he/she is likely to eat more or less than usual. This thesis focuses on establishing a method to build such a system.

The first step is to collect user data. Specifically, data on users' stress and eating

behavior, as well as the relations between them. One way of doing this is to use a chatbot. Compared with more explicit ways of acquiring data, such as questionnaires or interviews, a chatbot is obviously less intrusive and offers the possibility to collect data in a real-world setting instead of in laboratories. On the other hand, users are likely to be more adherent to chatbots compared to other types of cognitive-behavioral therapeutic (CBT) apps such as self-help web-based therapy (Barak et al. 2008) given their conversational and human-like nature, which is crucial in the context of this research (Fitzpatrick et al. 2017).

This thesis presents the design, implementation, and testing of a chatbot which collects data on the users' stress information and food consumed whilst being stressed, and presents a method to build a connection between the two on a per-user basis, i.e. building a stress-eating profile for a potential user. The following chapters will provide details regarding the design, realization, and evaluation of such a system. Chapter 2 formalizes the goal and requirements of the project. It will put the terms "stress detection", "dialogue-based self-reporting of stress" and "eating behaviors" into the context of this work.

1.1 Section

1.1.1 Subsection

See Table 1.1, Figure 1.1, Figure 1.2, Figure 1.3.

Table 1.1: An example for a simple table.

A	B	C	D
1	2	1	2
2	3	2	3

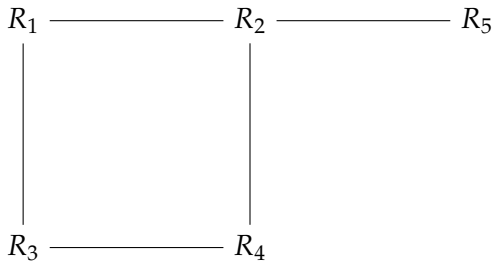

Figure 1.1: An example for a simple drawing.

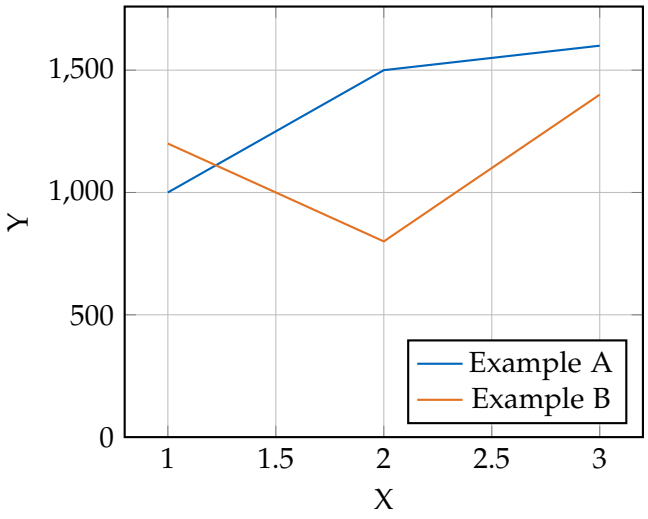

Figure 1.2: An example for a simple plot.

```
SELECT * FROM tbl WHERE tbl.str = "str"
```

Figure 1.3: An example for a source code listing.

2 Goal and Requirements

3 Related Work

4 System Design

5 Experiment

6 Data Analysis

7 Result

8 Conclusion

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