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Using Candlestick Charts to Predict Adolescent Stress Trend on Micro-blog

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Abstract

Surveys conducted by psychological institutions show that many teenagers suffer from stress in study, affection, and appearance shape nowadays. Coping with stress has become a major concern for teenagers. With the development of social media, the huge amounts of teens' tweets on micro-blog make it possible to sense teens' stress and predict their stress level change through their tweeting contents and behaviors. The finding results enable teachers and parents to know teenager' stress situations better, be aware of the possible stress level change in advance, and take actions to help stressful teenagers relieve stress. In this paper, we propose to use the candlestick charts which are widely adopted in stock analysis to predict teens' stress level change on a micro-blog platform. As different individuals have different stress changing characteristics, we define a stress pattern as a sequence of candlestick charts, and do stress pattern matching to judge if a candlestick chart with reversal signals will result in the trend reversal. Our experimental results verify the effectiveness of our candlestick charts based method in predicting teens' stress level change, compared to time series, MACD (Moving Average Convergence/Divergence), and KDJ (Stochastic Oscillator) based prediction approaches.

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1. Introduction

A survey, conducted by the American Psychological Association in August 2013, consisted of 1,950 adults and 1,018 teens in the U.S., found that teenagers are now the most stressed-out age group in the U.S.¹. On a 10 point stress scale, adults rate their stress at 5.1 while teens rate their stress levels at 5.8. 30% say that they feel sad or depressed as a result of stress, and 42% of teens say that they're either not doing enough to manage their stress or they're not sure if they're doing enough. As shown in the survey, conducted from October 2013 to April 2014 on 9100 students from 19 middle schools in Hong Kong², the most frequent stress they suffer came from study, examination, and appearance shape. 49.9% of the students had already developed light to severe symptoms of depression such as crying, hating themselves, or changing appetites. These investigations indicate that teenagers may suffer from a lot of stress, and they may need help in overwhelming them due to their insufficient experience. If teenagers' stress persists

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at high levels for a long time, it can have lasting negative effects on health, such as anxiety, high blood pressure, a weakened immune system, or even depression, obesity and heart disease³. Therefore, it is important for teenagers and their guardians realize the stress and manage it before the stress gets worse.

Nowadays, social media offers a new channel for teenagers to express themselves. They publish their daily lives, real-time feelings, and share ideas/emotions about news and surrounding events. Sometimes teenagers are more willing to express themselves on micro-blog rather than have an in-depth conversation with their parents or teachers when they suffer from stress. Teenagers become the main force on the social media, and by the end of 2013, users born after 1990 hold 53% of all the 600 million registered micro-blog users on the Chinese Sina micro-blog which is the largest micro-blog platform in China. The huge amounts of tweets posted by teens make it possible to detect teenagers' stress situations and predict the stress change with time through teenagers' tweeting contents and behaviors. According to the prediction results, teachers and parents can know teenagers' stress situations better, be aware of the possible stress change in advance, and help teenagers relieve stress.

In this paper, we use the candlestick charts analysis, a widely used technical analysis method in stock price prediction, to predict teens' stress level change on micro-blog. There are two challenges in addressing the problem. 1) In traditional candlestick charts analysis, they judge the trend change according to the appearance of some classic candlestick charts shapes or a combination of candlestick charts with trend reversal signals. However, different people may have different stress changing mechanisms. When a candlestick chart with trend reversal signal appears, the current stress trend of a teenager may continue or reverse depending on the teen's regulation power of stress. Therefore, we need to find out a teenager's stress changing patterns to help predict their stress level change. In this study, we represent a stress pattern as a sequence of candlestick charts, and do stress pattern matching to see if the reversal signals will result in the trend reversal finally. 2) To implement stress pattern matching, we need to match two candlestick charts in corresponding positions. How to describe a candlestick chart in a stress pattern and make the pattern matching more sensitive is a challenge. We extract five different features to form a candlestick chart feature vector (*SCF*). Then the distance between two candlestick charts can be measured based on the feature vectors. We compare our candlestick charts method with the time series model, MACD method, and KDJ method. Experimental results show that our method can predict the stress level change effectively, and perform better than all the other methods.

2. Related Work

Emotion detection on micro-blog. Sentiment analysis on micro-blog is achieved by analyzing the emotion information in users' tweeting contents and behaviors. The sentiment extracted from tweets is used in different applications, such as extracting people's opinions towards products⁴, stocks⁵ or political election⁶, etc. Golbeck *et al.*⁷ presented a model for understanding a user's personality from the Twitter profile using the "Big Five" personality structure, i.e., openness to experience, conscientiousness, extroversion, agreeableness, and neuroticism. In stress detection, various aspects are extracted from tweeting/retweeting contents and behaviors as features to detect the stress levels of a tweet using machine learning techniques on micro-blog^{8,9,10}.

Emotion prediction on micro-blog. Tang and Chen¹¹ predicted the changing process from tweet writer emotion to reader emotion based on the conversations corpus. To know which factors affect the emotion transition, they mined the conversations between posters and repliers on micro-blog, and classified into four possible emotion transitions according to the negativeness or positiveness of the posters and repliers. Mogadala *et al.*¹² predicted a user's mood transition by regression analysis on tweets posted over twitter timelines. By automatic labeling of tweets with mood labels using different features, a tweet is assigned a mood polarity score according to its mood labels. This total mood polarity score is then considered as a dependent variable, while tweet's time stamp is considered as an independent variable for mood prediction. Difference between time stamps and mood polarity scores of two consecutive tweets are taken to know the mood transition score, falling into three categories: positive, negative, or neutral mood transition. In Li *et al.*¹³, a multi-variant time series prediction model is used to predict a teenager's future stress level. By aggregating a teenager's stress levels using different aggregation functions at a certain time granularity, a number of aggregated stress sequences are generated for multi-variant time series prediction.

Our work differs from¹³ in two aspects. Firstly, rather than predicting the next concrete stress level, we predict the future stress level change of a teenager (i.e., the stress will increase or decrease). This trend prediction may be more intuitive to users rather than an exact stress level value. Secondly, we use a candlestick chart to describe the dynamic

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