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An Innovative Approach to Speedy Emergency Alert Using Tweet Analysis

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Abstract

There is a huge proliferation about the tweets recently. We are doing tweets by using some online social networks like twitter, face book etc. This work investigates the real time interaction of event such as earthquakes in Twitter and proposing an algorithm to monitor tweets and to detect a target event. To probe such interactions, devise a classifier using Support Vector Machine (SVM) of tweets based on keywords in a tweet, the number of words, and their context. It regards each user as a sensor, and analyzes a spatial and temporal pattern of an event and applies particle filtering which used for location estimation. Also developing an earthquake reporting system detects earthquakes and notification is delivered to nearest users and rescue team. This system detects earthquakes and notification is delivered faster than JMA broadcast announcements.

Keywords: *Twitter, Sensor, earthquake, location estimation, micro blogging*

1. Introduction

Twitter, a popular microblogging service, has become a new information channel for users to receive and to exchange information. It is an online social network used by millions of people around the world to stay connected to their friends, family members and co-workers through their computers and mobile phones [1].Everyday, nearly 170 million tweets are created and redistributed by millions of active users.Twitter has several unique advantages that distinguish it from news web sites, blogs, or other information channels. First, tweets are created in real-time. The tweets are in 140-character-message limit and the popularity of Twitter's mobile applications, users tweet and retweet instantly [2]. For example, we could detect a tweet related to a shooting crime 10 minutes after shots fired, while the first news report appeared approximately 3 hours later.

This work presents an investigation of the real-time nature of Twitter that is designed to ascertain whether we can extract valid information from it. We propose an event notification system that monitors tweets and delivers notification promptly using knowledge from the investigation. In this research, we take three steps: first, we crawl numerous tweets related to target events; second, we propose probabilistic models to extract events from those tweets and estimate locations of events; and developed an earthquake reporting system that extracts earthquakes from Twitter and sends an alert message to registered users as well as to the rescue team. Here, we explain our methods using an earthquake as a target event.

2. The proposed scheme

This paper proposes an algorithm to monitor tweets and to detect a target event and producing a probabilistic spatiotemporal model for target event that can find the center of event location. The proposed scheme uses a particle filter for location estimation. It can be achieved by regarding each user as a sensor, and analyzes a spatial and temporal pattern of an event and applies particle filtering which used for location estimation.

3. System model

We manually give a set of queries for the target event. For example, we will search for "earthquakes" and "shaking" if our target event is earthquakes. By searching every second, we can obtain a subset of tweet that all contains the keyword in our searching queries. Then, for each tweet in our searching result, obtain semantic features as its feature vector, then apply our classifier to the tweet and get a value positive and negative.

Application Creation: While creating the application, we'll assign the design fields like username, password, phone and other information. The user will enter the tweets through this application.

Server: The Server will analyze the user's contents. So, the server will extract the keywords from the tweets. Also the server will be retrieving the user information like access time and location which is used to find the user's location.

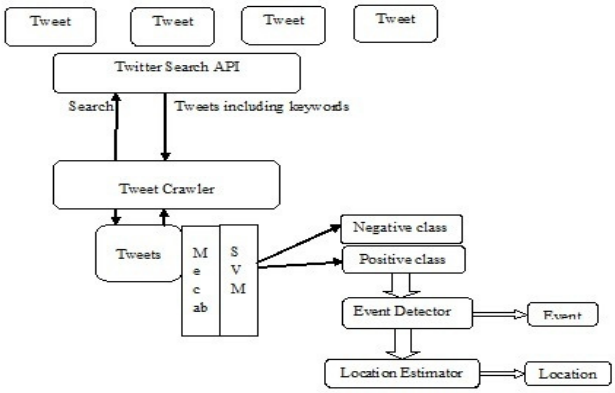

Fig.1. System Model

Extracting the Keyword Using Particle Filter: After successful creation of an application, the server will analyze the tweets and extract the keywords using Particle Filter. The Particle Filter will extract the keywords and filter the other words using the Stemming algorithm.
Automatic Alert to Rescue Team: After extracting the keywords, we send the SMS alert and Email to the rescue team once we attains the Maximum Peak of the extracted Keyword. Fig. 2.shows the sample e-mail alerts.

> Dear Alice,
> We have just detected an earthquake around chiba. Please take care.
> Toretter Alert System

4. Proposedmodel evaluation

The performance report of the proposed model with the existing model is described in this section. Table2 shows the classification performance.

Table 2:Classification Performance-i) Earthquake query

Features	Recall	Precision	F-value
A	87.50%	63.64%	73.69%
B	87.50%	38.89%	53.85%
C	50.00%	66.67%	57.14%
All	87.50%	63.64%	73.69%

Table 3:Classification Performance- Shaking query

Features	Recall	Precision	F-value
A	66.67%	68.57%	67.61%
B	86.11%	57.41%	68.89%
C	52.78%	86.36%	68.20%
All	80.56%	65.91%	72.50%

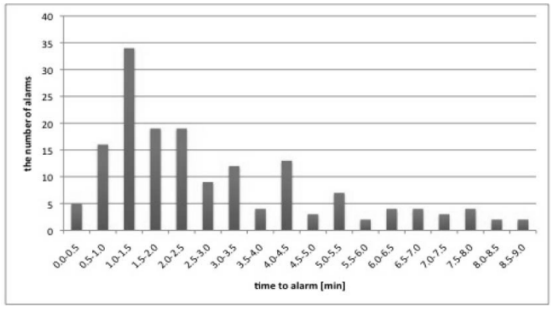

Fig .3.Frequent distribution of the time to send alarm e-mail. (x-axis: time to send e-mail[sec] y-axis: frequency of earthquakes, alarm trigger: 40 tweets in 10 minutes).

4.1 Event Detection

An event is an arbitrary classification of a space/time region. An event might have actively participating agents, passive factors, products, and a location in space/time. We target events such as earthquakes, tsunami, and traffic jams, which are visible through tweets.

4.1.1 Semantic Analysis

To detect a target event from Twitter, we search from Twitter and find useful tweets. To obtain tweets on the target event precisely, we apply semantic analysis of a tweet: For example, users might make tweets such as “Earthquake!” thus earthquake could be keywords, but users might also make tweets such as “I am attending an Earthquake Conference”. Moreover, even though a tweet refers to the target event, it might not be appropriate as an event report; for example a user makes tweets such as “The earthquake yesterday was scaring”, or “Three earthquakes in four days. Japan scares me.” These tweets are truly the mentions of the target event, but they are not real-time reports of the events. Therefore, it is necessary to clarify that a tweet is actually referring to an actual earthquake occurrence, which is denoted as a positive class. By preparing positive and negative examples as a training set, we use a SVM to classify tweets automatically into positive and negative categories [5]. We prepare three groups of features for each tweet as follows:
Features (Example: I am in Japan, earthquake right now!)

1) Statistical features (7 words, the 5thword): the number of words in a tweet message and the position of the query within a tweet.
2) Keyword features (I, am, in, Japan, earthquake, right, now): the words in a tweet.
3) Word context features (Japan, right): the words before and after the query word.

If we search the tweet and found out one user posted a relevant tweet, then we classify it into a positive class. The users function like a sensor of the event, therefore a tweet can be considered as a sensor output. In order to make our event detection feasible, we made the following assumptions:
1. Each Twitter user is a sensor, which detects a target event and makes a report following a certain probability.
2. Each tweet is associated with a time and location.

4.1.2Temporal Model

Each tweet is associated with its post time, and we use this information as the estimated occurrence time of our target event. We use GPS data and the registered location of a user as the location information, and we filtered out all the tweets without location information. We form a temporal model which gives the probability of event occurrence at time t, for a given tweet that is a positive example [6]. If the probability is larger than a predetermined threshold, then it determines an actual occurrence of the target event. This includes choosing an appropriate threshold and the build of temporal mode.:
1. The false-positive ratio *Pf* of a sensor is approximately 0.35.
2. Sensors are assumed to be independent and identically distributed.

4.1.3 Spatial Model

Each tweet is associated with a location. If the probability given by the temporal model is larger than the threshold, the next step is to determine the event location. We obtained the location information of each tweet using its associated GPS data or the registered location. We then apply particle filter to all set of tweet to obtain the event location .

4.1.4 Particle Filter

A particle filter is a probabilistic approximation algorithm implementing a Bayes filter, and a member of the family of sequential Monte Carlo methods. The whole algorithm is given as follows:
1. Put a query Q using search API every s seconds and obtain tweets T.
2. For each tweet tε T, obtain features A, B, and C. Apply the classification to obtain value v_t={0,1}.
3. If the enough number of tweets comes(p_{occur} in exceeds 0.99)then proceed to step 4.
4. For each tweet t ε T, we obtain the latitude and the longitude l_t 1) using the associated GPS location,2) making a query to Google Map for the registered location for user u_t. Set l_t= null if neither functions.
5. Calculate the estimated location of the event froml_t, t εT using normal particle filtering, particle filtering with assigned weights, and particle filtering with weights and sampling.
6. Send alert e-mails to registered users as well as to the rescue team.

4. Conclusions

In this paper we proposed a Real Time Event Detection by Twitter, which utilizes the real-time nature of Twitter. We consider each Twitter user as a virtual sensor, and use semantic analysis to classify tweets into a positive and negative class. We then decide to apply particle filtering into estimating the locations of events by regarding every user as a sensor. We can detect event occurrence in real-time and provide location estimation of events such as earthquakes. And also, we developed an earthquake reporting system development which provides the faster notification to all the registered users and as well as to the rescue team and it guarantees efficiency as well.

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