

# **School of Computer Science and Engineering**

## Rumour Detection on Online Social Networks Based on Sentiment Analysis

**Interim Report**

**Student**

xxx

**Supervisor**

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1. **Scope and Objective of Project**

This project aims to investigate and develop novel methodologies to enable detection of rumors from social media sources via sentiment analysis.

This report serves as a marker of progress that has been achieved since the inception of the report to the current time of writing, projected direction and work to be done on this project, and an updated project schedule based on the aforementioned considerations.

1. **Summary of Work Completed**

The following section describes all the work that has been completed for the project.

* 1. **Project Planning**

The initial planning phase consists of understanding the exact specifications and expectations from the project supervisor.

The key deliverables of this phase are the Project Schedule, and the understanding of the general research direction to pursue for this project.

The information harvester development was undertaken as the first task so that once the information harvester was function, the incremental collection of tweets could happen in tandem with literature review. Literature review is performed to inform the research direction and possible methodologies available for exploration in the remaining sections of the project.

* 1. **Information Harvester Development**

As it is a key requirement for this project to collect tweets for further analysis, a software has been developed on the Android platform to collect tweets in a reliable and robust manner. The software has the following features:

* Automated collection and compilation of tweets into user-configurable folder names
* Persistence of last collected tweet for reduction of bandwidth and duplicated tweets
* 7zip compression for compiled tweet archives for reduction of disk usage
* JSON-based configuration for easy configuration of software
* Additional metadata embedded (eg. received timestamp, request parameters) into tweet archives
* GUI Interface for starting and stopping tweet collection service, and for viewing statuses of tweet collection workers
  1. **Literature Review**

The following findings were yielded after performing literature review for papers related to rumors in both academic fields of Computer Science and Social Sciences.

Literature Review in Computer Science

* 4 Types of Rumor Detection methodologies: Content-based, User-based, Propagation-based, Others (Q Zhang, 2015)
* Affective Norms for English Words (ANEW) has been proven to be reliable for extracting emotional sentiment from dataset (Kim et al, 2009)
* ANEWs perform at a level that is similar to human coders (Kim et al, 2009)
* Tweet credibility is affected by topical content of tweets and social network structure (Canini et al, 2011)

Literature Review in Social Sciences

* Rumors and urban legends thrive on information and emotion selection (Chip Health, Chris Bell, and Emily Sternbern, 2001)
* Rumor Typology: Wish Rumors (projecting hoped results), Dread Rumors (projecting fears and disappointments) (Rosnow, Yost, & Esposito, 1986)
  1. **Feature Selection & Engineering**

The dataset that was collected was based on the search results from the query ‘#sickhillary’. The hashtag was created when Hillary Clinton faced a medical fiasco when she left the 9/11 memorial during 2016 in New York City, where she fell over and had to be held up by her bodyguards to enter her vehicle. The hashtag was then used by many twitter users as an attempt to cast doubts on whether Hillary Clinton was healthy enough to be the president of the USA. Tweets related to ‘#sickhillary’ were collected over a span of 3 months, beginning on 12th September 2016 and ending on 2nd December 2016, where over 84 thousand tweets were collected.

Prior to Feature Selection, the following steps were taken for preprocessing the data.

* Parsing of tweet archives into a MongoDB database
* Automated labelling of tweet type (Original Tweet, Retweet, and Quote Retweet)
* Removing duplicate tweets (ie. Tweets in the collection that had the same identifier.)

All the steps are performed automatically via a custom python program developed for this purpose.

For Feature Selection, the text component of the tweet was selected for further analysis.

For Feature Engineering, the following steps were taken to generate features for usage in machine learning techniques:

* Manual labelling of tweet sentiment into three categories
  + Support: Tweet supports the rumor, or using rumor to augment another argument
  + Deny: Tweet denies the rumor
  + Neutral: Tweet neither supports or denies the rumor
  + Unrelated: Tweet content is unassociated with the rumor associated with the hashtag.
* Generation of top terms of all tweets by frequency of observed terms in tweet text
  + Top terms only include terms that fall within +/- 3 standard deviations of term frequency.
* Generation of term frequency vector by tweet (based on top terms observed)
* Generation of term binary frequency vector by tweet (ie. ‘1’ means term exists in tweet, ‘0’ means term does not exist in tweet)

The following steps were also taken in the discovery process during this phase.

* Synthesis of a graph of tweets based on the relation between tweets (ie. A node represents a tweet, and an edge represents that one node is a retweet of the other)
* Visualization of graph of tweets
  1. **Sentiment Analysis using Machine Learning Techniques**

The following sentiment analysis techniques were used:

* Stopword removal of terms
* Stemming of terms using Porter stemmer

The following machine learning techniques were used:

* Unsupervised agglomerative clustering based on term binary frequency vectors
  1. **Interim Report Writing**

The Interim Report (this report) was written as per requirements of the Final Year Project.

1. **Forecasted Work**

The following section describes all the work that is sought to be completed by the end of the project.

* 1. **Feature Selection & Engineering**

More features will be experimented with and engineered to attain higher classifier accuracy ratings. Additionally, additional datasets will be acquired via collection of tweets to draw more conclusions from the new datasets.

* 1. **Sentiment Analysis using Machine Learning Techniques**

Efforts will be put into experimenting with methods such as Sentiment Dictionaries such as Affective Norms for English Words (ANEW) and Topic Modeling. Other machine learning techniques such as decision trees, support vector machine, and neural networks will also be experimented with.

* 1. **Full System Integration**

An integrated system with a web front, consisting of all previously mentioned components, will be to provide an easy-to-use interface for users to easily gain insights of the achievements of the project.

* 1. **Final Report Writing**

A Final Report will be written as per requirements of the Final Year Project; it will contain a comprehensive documentation of all activities and findings of this project.

* 1. **Oral Presentation**

An Oral Presentation will be delivered to the grading committee as per requirements of the Final Year Project, presenting the project’s activities and findings in a succinct and engaging manner.

1. **Summary of Problems Faced**

This section provides a brief listing of all problems faced, grouped by the component of the project in which the problem was faced.

* 1. **Information Harvester Development**

The challenges faced in this phase are mostly domain-specific with regards to developing software on the Android platform.

1. Inconsistent Storage Implementation across Android Versions

Different manufacturers of Android phone implement storage options for applications differently. For example, phones may or may not have external SD storage. This has direct implications to where the application will choose to store the tweet archives, as external SD storage is preferred so as not to use disk space on the phone. The technical solution to this problem was to have two configuration files. The first configuration file resides in the Internal Storage, a directory that is guaranteed to exist, and it stores the path to the actual storage location that the app needs to access. The second configuration file, which resides in the External Storage, contains the user’s configuration files. In the event where there is an absence of external SD storage, the application will then default to internal storage.

1. Tackling Android’s Automated Task-killing

Android will automatically kill tasks which it deems to be idle, and this poses a problem for the application, as the application should not be killed as it needs to collect tweets in a consistent and reliable manner. This is solved by using Persistent Services, where the service, which is used to instantiate the web requests to retrieve tweets, is attached to a notification.

* 1. **Literature Review**

The main challenges faced with the literature review were mostly surrounding the understanding of mathematical notations, but the explanations provided by the authors of the papers reviewed greatly assisted in my understanding of their methodologies.

* 1. **Feature Selection & Engineering**

The challenges faced in this phase can be grouped into the following categories:

1. Coercing of Data

Due to the inconsistencies of data types used across different domains, a notable amount of time had been spent on ensuring that the data was properly parsed and stored during the various stages of the data processing. For example, in order to utilize MongoDB’s date search functions, a tweet’s datetime must be converted into a correct format, else MongoDB would simply treat the field as a string.

1. Long Data Processing Times

Search queries into the MongoDB database take a long time, even with merely 80 thousand tweets. Thus, specifying only fields which are necessary for a given task helps to shorten the time taken for a search query.

* 1. **Sentiment Analysis using Machine Learning Techniques**

The challenges faced in this phase are mostly due to the general unfamiliarity of the tools used. This problem has been gradually overcome through the consultation of the relevant documentation of the tools utilized.

1. **Amended Project Schedule**

The following Gantt chart details the amended project schedule.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | SEMESTER 1 2016/2017 | | | | | | | | | | | | | | | | | | | | SEMESTER 2 2016/2017 | | | | | | | | | | | | | | | | | |
| **Date Task** | **AUG** | | | | **SEP** | | | | **OCT** | | | | **NOV** | | | **DEC** | | | | **JAN** | | | | **FEB** | | | | **MAR** | | | | **APR** | | | **May** | | | |
| Project Planning |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **E X A M** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **E X A M** | |  |  |  |
| Information Harvester Development |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Literature Review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Feature Selection & Engineering |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Feature Selection R&D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Feature Engineering R&D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sentiment Analysis using Machine Learning Techniques |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sentiment Analysis Techniques R&D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Machine Learning Techniques R&D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Result Testing and Verification |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Interim Report Writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Full System Integration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Final Report Writing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Oral Presentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |