

Evaluating the Changing of Risk Level By Text Analytics and Visualization

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ABSTRACT

In VAST Challenge 2021 Mini Challenge 3, text analysis and visualization were leveraged to provide useful information for public to take appropriate actions.

1. INTRODUCTION

In the country island of Kronos, the increasing noxious effects on health and farming have been related to the uncontrolled activity of GAS tech, a natural gas operator, supported by corrupt government officials. On January 20th, 2014, a corporate meeting is held to celebrate the new-found fortune because of the initial public offering of the company. However, a series of rare events occur that lead to the disappearance of several employees. The Protectors of Kronos (POK), a social movement organization that has been fighting against water contamination and government corruption, is suspected in the disappearance.

As analysts, we were assigned with several tasks in order to identify risks and how they could have been mitigated more effectively.

The objective is to evaluate the changing levels of risk to the public and recommend actions for first responder:

- Distinguish meaningful event reports from typical chatter from junk or spam.
- Evaluate the level of the risk to the public evolves over the course of the evening. Consider the potential consequences of the situation and the number of people who could be affected.
- Determine the appropriate location for first responders.
- The differences between dealing with this challenge in 2014 and dealing with it now.

2. DESIGN FRAMEWORK

The application uses the free and open-source R language that offers a thriving programming environment for statistical and graphical analysis. Our 4 design considerations for development:

- Performing calculations/logic within R for reproducibility,
- Using standard R packages on the Comprehensive R Archive Network(CRAN) for supportability.
- Using Shiny to webify the codes for simplicity.
- Providing options and visualizations for interactivity.

2.1 Data Source

There are three dataset in Mini-Challenge 3:

- Microblog records that have been identified by automated filters as being potentially relevant to the ongoing incident.
- Text transcripts of emergency dispatches by the Abila, Kronos local police and fire departments.
- maps of Abila and background documents.

The data of Microblog and text transcripts of emergency dispatches are found in three segments:

- Segment 1 :“csv-1700-1830.csv” - covers the time period from 1700 to 1830 Abila time on January 23.
- Segment 2: ”csv-1831-2000.csv”- covers the time period from 1830 to 2000 Abila time on January 23.
- Segment 3: “csv-2001-2131.csv” - covers the time period from 2000 to shortly after 2130 Abila time on January 23.

The number of “Total Message”, “Message Blog” and “Call Center” is 4063, 3872 and 191.

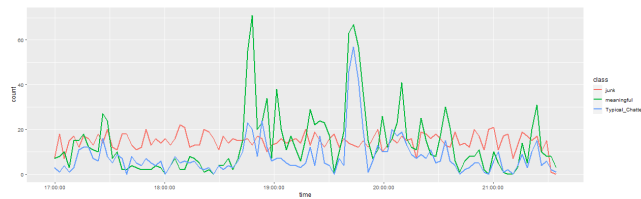
2.2 Data Preparation

All data preparations are performed using R. We combined the data of Microblog and text transcripts and convert the date variable to right time format, which is necessary for the following analysis. And based on content of data provided, we classified records into three segments: Junk, Typical_Chatter and Meaningful records. + Junk: Referred to advertisements or financial purpose reports. + Meaningful: Refers to informative records which spread real news about ongoing or impending events happen in Aliba. + Typical Chatter: Represents no meaningful and irrelevant or inappropriate messages post online.

3. MESSAGE LABELING

Using “Figure 1” to show the number of different types of messages posted every two minutes from 17:00 to 21:30. + For meaningful news, there are two peaks around 18:40 and 19:40, and the corresponding events are the dancing dolphin fire incident and the black truck incident.

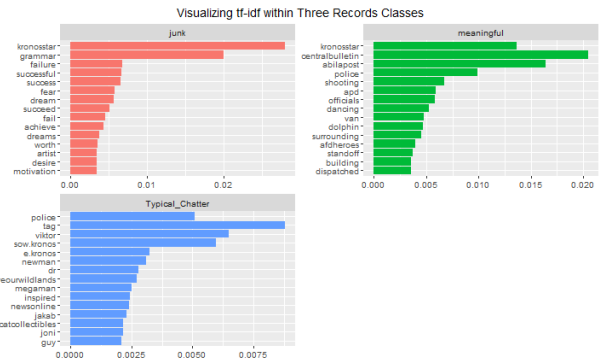
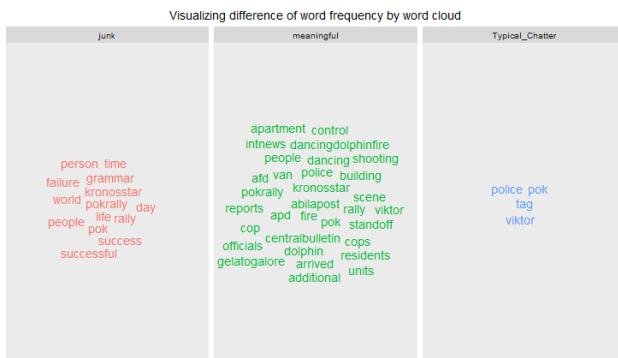
- For typical chatter, the peak at 19:40 coincides with the peak of meaningful messages.
- For junk, there was no obvious peak in the number of messages during the night period.



3.1 The difference of key words

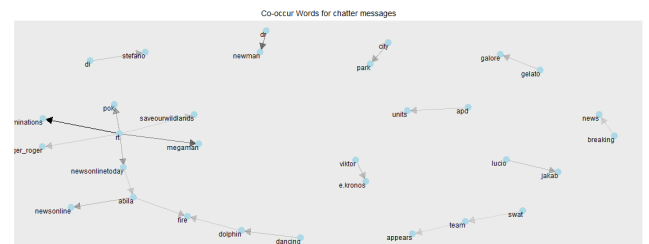
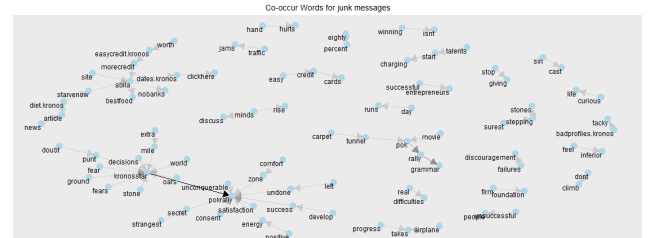
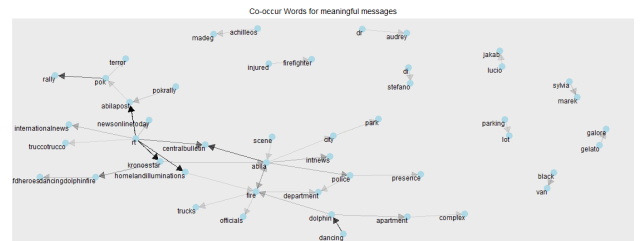
3.1.1 Single word frequency

For junk records, its most frequent words are relate to “life”, “successful”, “time”, the style of junk record is more macroscopic. However, for meaningful records, its frequents words seems to be more various, and it contains important social-event topic words, such as “fire”, “rally”, and “van”. Comparably, the common words of typical-chatter are fewer and people usually end with a metatag “tag” if they post typical-chatter records. Since POK rally invested Viktor-E bank to play music, Viktor become the People Focus in typical-chatter.



3.1.2 Co-occur word frequency

Compare Figure 4 to Figure 5 and 6, it is more frequently for words appear together in meaningful message than those appear in junk messages. This indicate that meaningful messages have more converge topics. Therefore, there were more fixed words groups in meaningful messages.



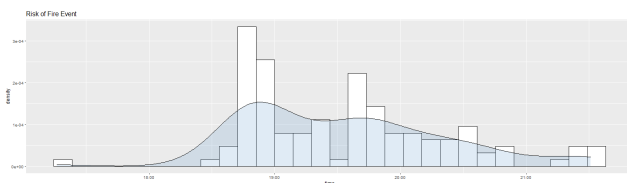
3.1.3 Frequency comparison of key words in three classification

speaker Dr. McConnel Newman. At 18:45, Guest bank Victor-E return to stage and plays for approximately 20 minutes.

- phase 3: At 19:07, Marek goes to stage to thank everyone for supporting POK. Bank Victor-E displays for one more hour. The rally closed around 19:05, so we can see the rally topic density dramatically drop down.

4.0.2 Event 2: Fire Accident in Dancing Dolphin

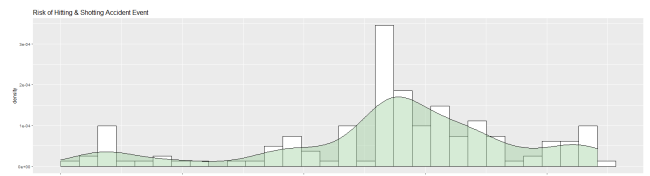
Using the hash tags and key words about fire accident, the relative posts on social website have been filtered out. And the count of relative records reflect the event risks during this period. The fire event started at 18:25 and involved a fire at the Dancing Dolphin apartment complex, located at the corner of N Achilleos St. and N Madeg St. With the events development, fire event experienced 4 different phases.



- Phase 1: at the 18:25pm, a witness GreyCatCollectibles reported some precursor of the fire firstly and call the Fire Department.
- Phase 2: at 18:42 pm, two fire trucks are dispatched, and two police cars arrive to management the crowd. Fireman help evacuating the residents, then the first peak occurs. At 18:59, a resident trapped on upper floor was rescued. However, the fire continued and officials expanded evacuation area at 19:25:00.
- Phase 3: At 20:05, CentralBulletin reported that an injured firefighter rescued from the fire, Around 20:25 officials stated fire was under control, but after 10 minutes AFD requested additional trucks, reported by AbilaPOst at 20:52. Several minutes later, the top floor of dancing dolphin collapsed.
- Phase 4: At 21:15, KronosStart, HomelandIlluminations and AbilaFireDept issued conflicting reports. According to KronosStart and HomelandIlluminations, AFD stated that the fire was nearly under control, but AbilaFireDept said the fire had not been controlled. At 21:30, AFD reported an explosion at the Dancing Dolphin, then the risk is going up again.

4.0.3 Event 3: Hitting & Shooting Event

The same method was used to select records about Hitting and shooting event. The shooting event is an extension of hitting accident, so we integrate these two events into one for better evaluation and simulation of the whole event. Based on the event processes, hitting and shooting event could be divided into 4 phases.



- Phase 1: At 19:19, Abila Police Department reported a car hit on Souliou street, and @ hennyhenhendrix reported a black van hit his car. During this period, many tweets also report a black van hit a bicyclist, a witness KronosStar at 19:35:07 said the bicyclist was uninjured, The van hit and then escaped, police pursued it.
- Phase 2: At 19:40, Abila Police reported gun fire at Gelato Galore near the City Park, and the shooters were in the black van. In the shooting fire, a cop was gunned down and witness said that there are hostages controlled by gunman. At 19:43, ambulance arrived at scene of standoff for the wounded officer.
- Phase 3: Around 20:11, negotiations between shooter and police began. The standoff continues until about 21:00.
- Phase 4: At 21:13, the two van guys fought with each other, and two kidnapers dropped the gun and gave up. In the end, two hostages were saved and two terrorists were arrested.

5. RESPONDERS ALLOCATION

To send the responders, we chose dancing dolphin department. From the chart, we set the risk level for each event and use the light color dots represent low risk events and dark color dots represent high risk events. Since the potential consequences of fire in dancing dolphin apartment and black van are all severe, the locations of these two incidents are close. It will be easy for police department to control the severe incidents not only the dancing dolphin but also the black van.





6. CONCLUSION & RECOMMENDATION

In this project, we utilize text analytics and visualization methods to present how to identify the Microblog messages from junk, meaningful and typical chatter, which would be helpful for police to tell useful information and discard useless information.

Based on the data provided, the risk of 3 most risky events are simulated and evaluated from 17:00 to 21:30 pm. With the event developments, multiple event phases have been divided, the event details could be in Event Evaluation above. Since the fire event and hitting & shutting event have the most significant impacts for social security, it is recommended that police and fireman are ready at all time to the region of Dancing Dolphin Apartment Complex and Souliou street between 17:00pm and 21:30pm. In particular, it is necessary for Fire Department to prepare enough fire truck and force to Dancing Dolphin Apartment and tried to put out the fire in the shortest time, avoiding fire spreading. For hitting & running event, because shooting event is the extension of hitting accident, it is quite important to restraint the further development of hitting accident, in this case, the third shooting event could be avoided. Thus, we would like to suggest for police to prepared well at Souliou street to prevent the escape of terrorists.