

# NERFHERDER: News-Extracting Reader and Filter for Helping Emergency Responders Deliver Effective Results

## Data Collection Report

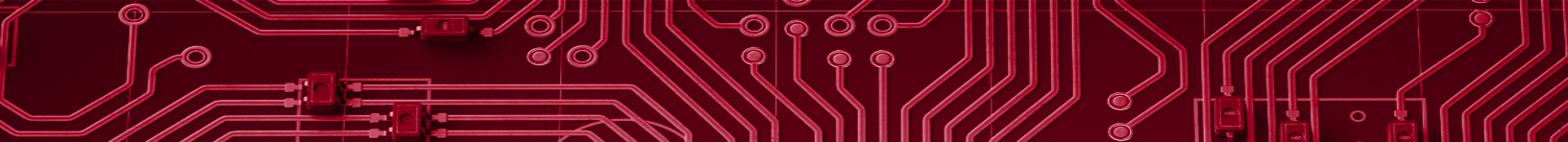
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## FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory organized within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of state and local first responders to address the homeland security mission. The laboratory provides first responders with the necessary services, products and tools to prevent, protect against, mitigate, respond to and recover from homeland security threats and events.

DHS S&T works closely with the nation's emergency response community to identify and prioritize mission capability gaps, and to facilitate the rapid development of critical solutions to address responders' everyday technology needs. DHS S&T gathers input from local, tribal, territorial, state and federal first responders, and engages them in all stages of research and development. This includes everything from building prototypes and operational testing to transitioning tools that enhance safety and performance in the field. The ultimate goal is to advance technologies that address mission capability gaps in a rapid time frame, and then promote a quick transition of these technologies to the commercial marketplace for use by the nation's first responder community.

As projects near completion, NUSTL conducts an operational field assessment (OFA) of the technology's capabilities and operational suitability to verify and document that project goals were achieved. Based on technology specifications or limitations, a technology demonstration or data collection effort may be conducted in lieu of an OFA.

NUSTL's OFA, data collection and technology demonstration reports are posted on the DHS S&T Technology Clearinghouse website to provide stakeholders with curated information to aid in the development of innovative technology solutions for homeland security. DHS S&T's publicly accessible reports are available at [www.dhs.gov/science-and-technology/technology-clearinghouse](http://www.dhs.gov/science-and-technology/technology-clearinghouse).

Publicly released reports specific to first responders are available at [www.dhs.gov/science-and-technology/frg-publications](http://www.dhs.gov/science-and-technology/frg-publications).

For more information on other projects relevant to first responders, visit the DHS S&T website, [www.dhs.gov/science-and-technology/first-responder-technologies](http://www.dhs.gov/science-and-technology/first-responder-technologies).

For more information on NUSTL programs and projects, visit the NUSTL website, [www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory](http://www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory).



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## EXECUTIVE SUMMARY

Every day on Twitter, up to 500 million tweets are sent (Twitter Usage Statistics, 2020), sharing a tremendous amount of data with users. The frequency with which tweets are generated often increases during emergencies or major incidents, representing an external source of information that could be tapped by responders; however, accessing the right information at the right time to make actionable decisions is challenging due to the massive volume of data.

To address this technology gap, the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) funded the development of the News-Extracting Reader and Filter for Helping Emergency Responders Deliver Effective Results (NERFHERDER) tool. NERFHERDER was developed by ExoAnalytics Solutions Inc. to be a data-sifting social media ingestion system capable of helping first responders gain improved situational awareness from Twitter feeds without the persistent attention of the user.

On October 16, 2019, the National Urban Security Technology Laboratory (NUSTL) conducted a technology demonstration of NERFHERDER, focusing on the usability and functionality of the technology. One firefighter from California, two intelligence specialists from the U.S. Coast Guard, two emergency management experts from New York City's Emergency Management Department (NYCEM), a law enforcement officer from Huntingdon County Sheriff's Office, and a Cyber Intelligence Unit member from the New York Police Department (NYPD) served as evaluators during the demonstration and provided feedback on the usability, functionality and suitability of the technology for their typical field operations.

Evaluators found the user interface to be nonintuitive and difficult to both navigate and analyze the results of Twitter searches. Evaluators highlighted the cumbersome nature of the start-up process, which required manually clicking through three unique start-up buttons. Once running, the system generated three unique windows, of which only two were intended for user interaction. A shared concern among evaluators included issues with navigating between the different screens and windows once the system was fully initialized.

Evaluators noted that NERFHERDER's hashtag stack trace feature, which could empower an analyst to identify connections between incidents, was a unique and valuable function. Other constructive comments included the need for a more streamlined user interface, as well as the desire for additional features such as a map-based feature that uses layers to overlay relevant information. In its current state, all the evaluators agreed that they would not use NERFHERDER if it were available and would not recommend that their agency acquire it. Evaluators articulated that changes to the graphical user interface, such as minimizing the number of windows that are open, streamlining the workflow, incorporating a time stamp and including searchability by geographic location, as well as adding adjustability of refresh rate, would make the application more suitable for their missions.

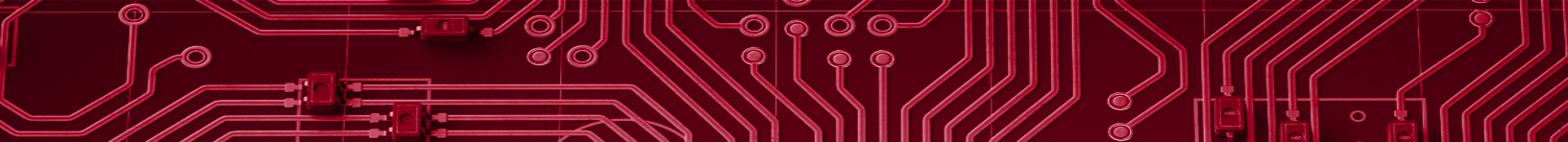


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## 1.0 INTRODUCTION

Every day on Twitter, up to 500 million tweets are sent (Twitter Usage Statistics, 2020), sharing tremendous amounts of data with users. The frequency with which tweets are generated often increases during emergencies and major incidents, representing a massive external source of information that could be tapped by responders.

It is impossible for any individual to read and digest every social media post made in a day, let alone read every tweet sent from the vicinity of an incident site in real time. Although such information could be useful to incident managers, the overwhelming nature of the volume of social media posts makes it challenging for incident managers to include this type of information in their decision-making process when making important, time-sensitive decisions.

To address this technology gap, the U.S. Department of Homeland Security's (DHS's) Science and Technology Directorate (S&T) funded the development of the News-Extracting Reader and Filter for Helping Emergency Responders Deliver Effective Results (NERFHERDER) tool. NERFHERDER was developed by ExoAnalytics Solutions Inc. to be a data-sifting social media ingestion system capable of helping first responders gain improved situational awareness from Twitter feeds without the persistent attention of the user.

On October 16, 2019, the National Urban Security Technology Laboratory (NUSTL) conducted a technology demonstration of NERFHERDER in New York, New York, focusing on the usability and functionality of the technology. This demonstration included the following evaluators: one firefighter from California, two intelligence specialists from the U.S. Coast Guard, two emergency management experts from New York City's Emergency Management Department (NYCEM) and a Cyber Intelligence Unit member from the New York Police Department (NYPD). Throughout the technology demonstration the evaluators provided feedback on the usability, functionality and suitability of the technology for their typical field operations.

This report describes the demonstration conducted by the vendor, the results from the demonstration and the evaluators' feedback.

### 1.1 PURPOSE

The purpose of the data collection demonstration was for first responders to assess the functionality and use of NERFHERDER for situational awareness and provide feedback on the system's capabilities.

### 1.2 OBJECTIVE

The objective of this demonstration was to:

- Determine NERFHERDER's usability by local law enforcement personnel during typical field operations
- Evaluate the features and functions of NERFHERDER as described in their contract (70RSAT18CB0000026) with DHS S&T.

### 1.3 PARTICIPANTS

Table 1-1 lists the demonstration participants. Seven evaluators from five different organizations participated along with DHS staff members, the technology developer and observers.

Table 1-1 Participants

Role	Organization
Evaluators	<ul style="list-style-type: none"><li>• NYCEM (New York)</li><li>• NYPD Cyber Intelligence Unit (New York)</li><li>• Huntingdon County Sheriff’s Office (Pennsylvania)</li><li>• San Diego Fire/Rescue (California)</li><li>• U.S. Coast Guard (Kentucky and Missouri)</li></ul>
Venue Host	DHS S&T NUSTL
Program Managers and Support Staff	DHS S&T
Test Director and Data Collectors	DHS S&T NUSTL
Technology Developer	ExoAnalytics Solutions Inc.
Observers	U.S. Coast Guard Research & Development

### 1.4 REQUIREMENTS

The genesis and requirements for this project are documented in, “*Integration of Public Data Feeds Statement of Objectives (SOO)*” (Department of Homeland Security - Science and Technology Directorate, 2017). The document states that the purpose of a proposed solution for integrating public data feeds, “is to allow for the use of both authoritative and informational application feeds... and select publicly-shared social media in a variety of typical, standards-based COPs [common operating pictures] already in use (e.g., Next Generation Incident Command System (NICS), global information systems (GIS), Google Earth, etc.). Further, it should include the ability to provide automated alerts based on specified, tailorable triggers and thresholds to inform incident commanders and emergency responders of potential or emerging threats for increased situational awareness.”

Section 5.1 of the “*Integration of Public Data Feeds Statement of Objectives (SOO)*” provides a list of the “Must Have Requirements.” These requirements have been reproduced below in Table 1-2.



Table 1-2 Integration of Public Data Feeds Requirements

Requirements
Seamlessly integrate with a variety of common operating pictures (COPs) and communications platforms (e.g., smartphone, tablet, laptop, etc.) and their associated operating systems without negatively affecting functionality or response time
Provide user-defined triggers, warnings and alerts (such as an increase in particular hashtags, social media “check-ins” at particular locations, etc.) in multiple formats (e.g., visual text, voice alert, vibration, etc.) selected based on user conditions that can be changed from the application interface by the user during an event
Be able to display data in multiple formats (e.g., images, text) allowing user control over icons, spatial and temporal filtering, etc.
Be open source, open standards-based (National Information Exchange Model compliant) to support platform interoperability, allowing it to augment local COPs with all-source data or otherwise easily interface with various local emergency management COP systems, to include Next Generation Incident Command System, global information systems, Google Earth, and WebEOC
Provide an intuitive graphical user interface, which will require no additional programming
Provide the ability for users to toggle which social media feeds to pull data from
Provide the ability for users to easily include newly acquired information feeds into the system
Offer command-level triggered alerts that would override individually pre-set, user-defined triggers
Allow development of user profiles, including customized tags, triggers and searches
Be scalable to work with technology as the COP systems and hardware systems upgrade
Be capable of providing an output summary as defined by the user such as data relating to an incident, time frame or location. The format should be one that is easily assimilated in common office productivity software such as Word, Outlook and Excel, and will be more specifically defined by first responder subject matter experts during development
Integrate social media sharing so elements of triggered alerts can be integrated into an emergency alert and SMS/MMS (short message service/multimedia message service) messages
Ability to perform basic data analysis to validate sources and identify trends
Mechanism to use orthogonal data to validate data stream (may be done using a percentage or scoring mechanism)
Software must have the capability to selectively filter data sources deemed inaccurate or questionable

The contract between DHS S&T and ExoAnalytics Solutions Inc. (Rodenzo, 2018) does not reference requirements, but instead guides ExoAnalytics Solutions Inc. to adhere to a “statement of work” when developing the technology solution. Accordingly, NERFHERDER does not address the full list of requirements found in Table 1-2. The salient scoping statements from the contract can be found in Table 1-3.

**Table 1-3 Statement of Work from Contract 70RSAT18CB0000026**

<b>Statement of Work</b>
Ingest data from at least one social media source. The prototype shall read social media postings from a Twitter feed (live or pre-downloaded)
Assess ingested data for relevance, using pre-set parameters. The prototype shall filter ingested Twitter postings for pre-selected and pre-loaded hashtags
Assess ingested data for relevance, using in-situ, user-defined parameters. The prototype shall filter ingested Twitter postings for hashtags selected and entered by a user
Generate a relevance measure for human consumption. The prototype shall produce some visualization of relevance to a first responder mission need
Recognize personally identifiable information (PII) that may be present in ingested data. The prototype shall internally note content in live Twitter postings that contains PII.

## **1.5 SYSTEM DESCRIPTION**

NERFHERDER is a desktop software package that is intended to collect and utilize publicly accessible data feeds, specifically Twitter, to increase situational awareness for first responders in pursuit of their mission.

The main capabilities of NERFHERDER focus on searching hashtags. Hashtags are keywords that are prefixed with the hash character (#) by Twitter users to facilitate searching for and grouping tweets on a given topic. NERFHERDER users can pre-load common hashtags of interest or set hashtag search parameters. Once a search is conducted, users can then review Tweets affiliated with the hashtag, and engage in “hashtag stack-tracing,” that is, viewing how one set of hashtags are related to others that they were found with. Another important feature is personally identifiable information (PII) stripping.

For example, a first responder who is monitoring Twitter feeds about an urban fire in a residential building would consider searching “#buildingfire” in an effort to learn more about the situation from members of the public who have documented and shared the incident via Twitter. In this same example, the “hashtag stack-tracing” feature might uncover other hashtags that the fire responder did not think to investigate, such as the neighborhood (e.g., #SohoFire) or the street name (e.g., #Delancey).

Users of NERFHERDER are currently required to obtain a Twitter developer account, which establishes agreements and protocols for accessing Twitter data through an application program interface (API) to use the software. For the technology demonstration, the evaluators did not have their own Twitter developer accounts. As such, the evaluators were not able to gain any hands-on experience, and only observed the developers using the system.

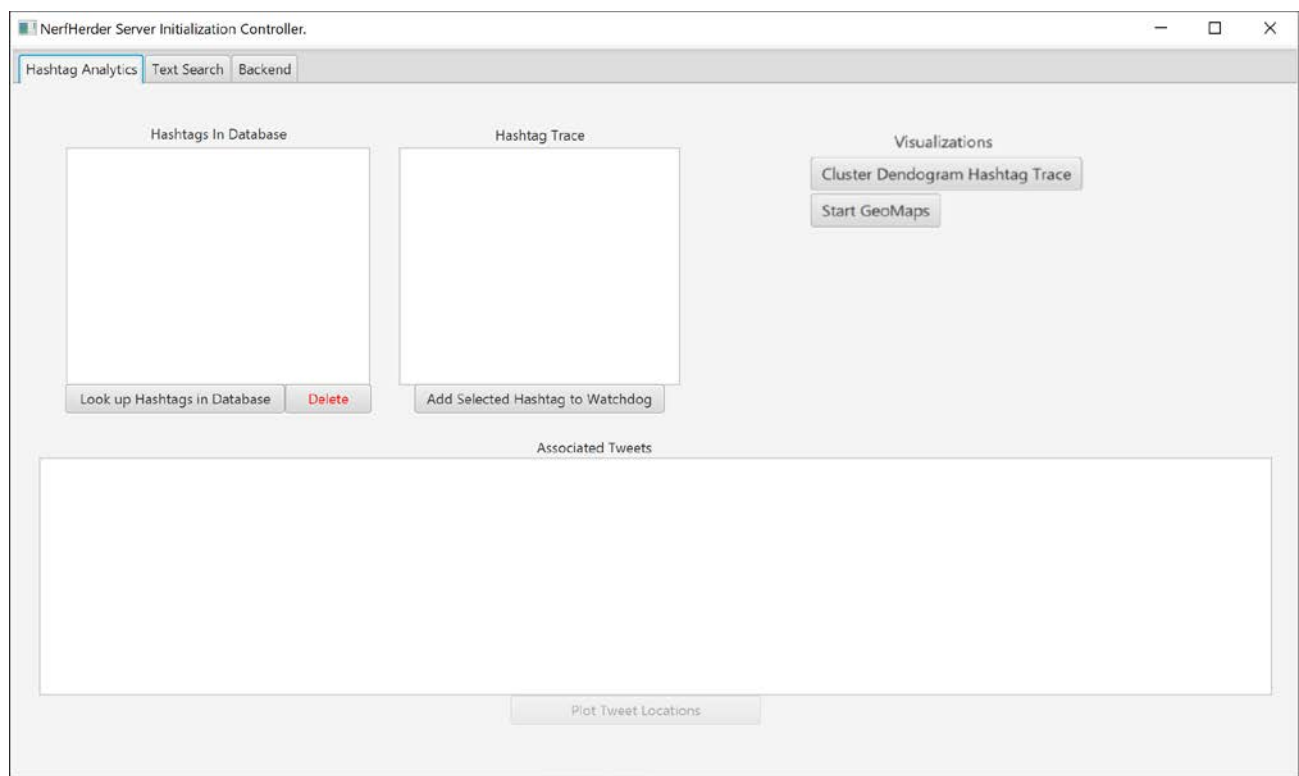


Figure 1-1 Primary User Interface Screen for NERFHERDER

## 2.0 DATA COLLECTION DEMONSTRATION DESIGN

This demonstration was designed as a one-day event, bringing together seven emergency response subject matter experts from five different agencies to evaluate NERFHERDER. Evaluators were encouraged to ask questions and provide feedback as the developer demonstrated the functionalities of NERFHERDER. At the end of the demonstration, evaluators were asked to fill out a survey and participate in a debrief discussion to solicit additional feedback on the software application.

### 2.1 EVENT DESIGN

The demonstration was conducted in a conference room at NUSTL in New York, New York, where the developers walked the evaluators through the various features and functions of NERFHERDER. This included the activities listed below.

Data collectors from NUSTL recorded observations and comments during each activity. One data collector was assigned to each group of evaluators. Observers from federal agencies attended the demonstration and also provided feedback. The data collection plan contains complete details of the data collection demonstration.

1. Highlight and discuss the most salient elements of the Primary User Interface Screen (Figure 2-1). The salient elements include the hashtags in database, the hashtag trace search terms and the associated tweets.
  - a) The hashtags in database is a list of the hashtags that the user wants to search.
  - b) The hashtag trace is a list of associated hashtags that were found after an initial search. In the image below, they are ordered in descending order from most common associated hashtag (“subway” with 62 associated hashtags found) to least.
  - c) The associated tweet box allows the user to read the contents of the actual tweet that contained the hashtags of interest.

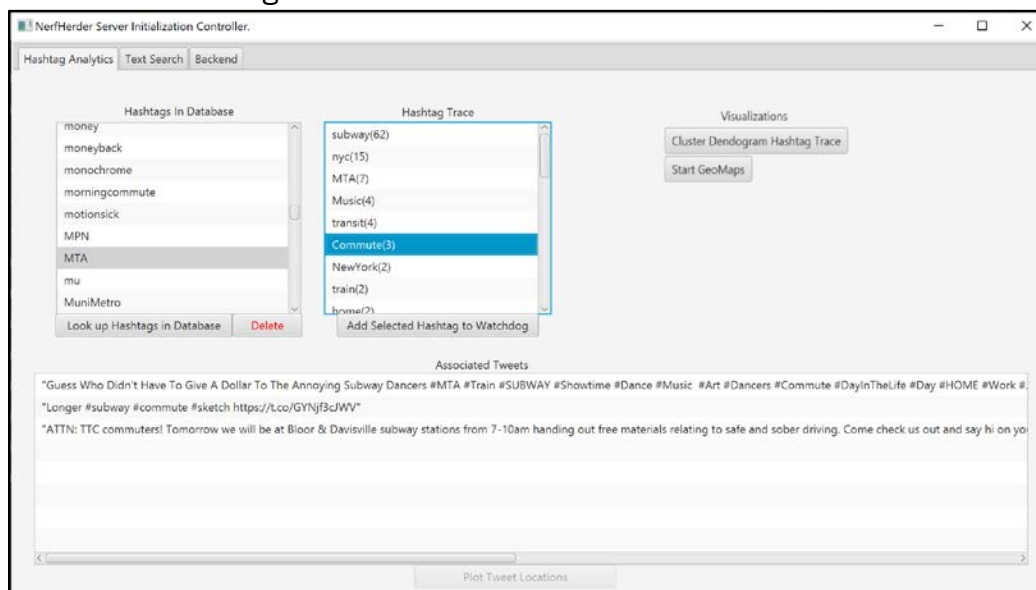


Figure 2-1 Annotated Primary User Interface Screen



2. Discuss the role of the watchdog control panel. Watchdog is the term used to describe the search word database that contains commonly searched terms and terms of interest to the end user. Watchdog is intended to allow the end user to more efficiently manage their searches and is used to populate the results in NERFHERDER (Figure 2-2). The developer demonstrated the following tasks:

- Add Search to Watchdog
- Remove Search from Watchdog
- Single<sup>i</sup> vs Automatic Watchdog Cycles

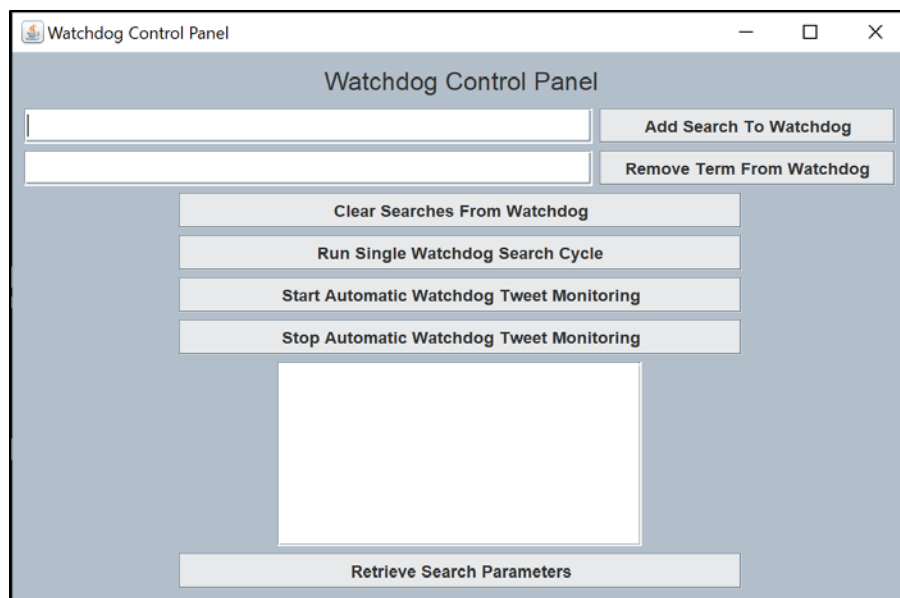


Figure 2-2 Watchdog Control Panel

3. The technology developer has included a set of hashtags they have determined to be of priority importance to the first responder community. The developer discussed the pre-loaded set of hashtags and the intent behind including them.
4. Walk through the hashtag search features (Figure 2-3).

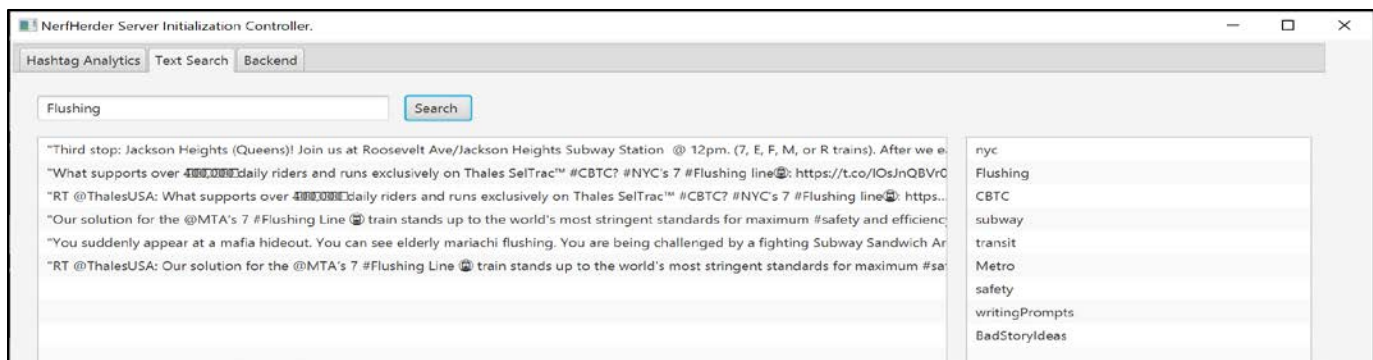


Figure 2-3 Tweet Review Box

<sup>i</sup> This action was not executed by the developer during demonstration.

5. Demonstrate how to add hashtags to the database.<sup>ii</sup>
6. Demonstrate the Tweet Review features and discuss the PII stripping feature.
7. Walk through the hashtag stack-trace feature, a visualization tool that illustrates the relationships between the hashtags of interest and affiliated hashtags that were tweeted with it (Figure 2-4).
8. Load the hashtag stack-trace visualization for one of the previously used hashtags and discuss the image that is loaded.
9. Demonstrate the GeoMaps feature (Figure 2-5) as a way to visualize where tweets are emanating from.

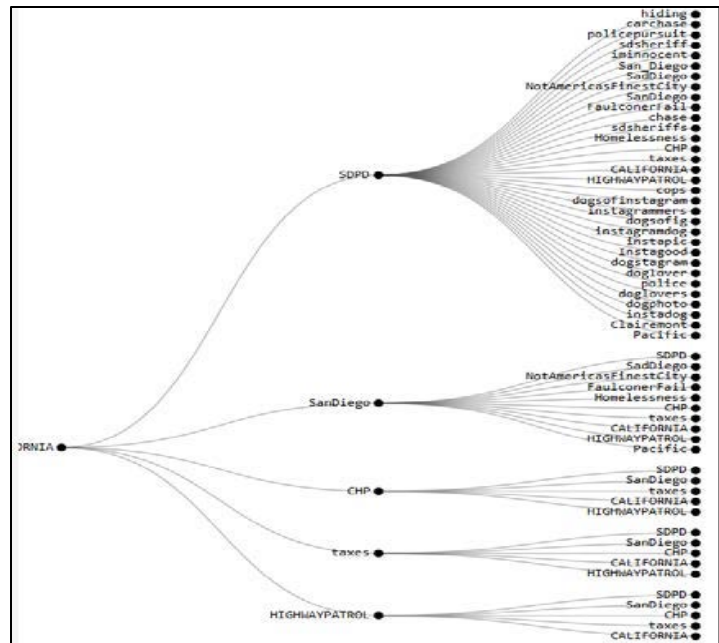


Figure 2-4 Visualization of the Hashtag Stack-Trace Feature

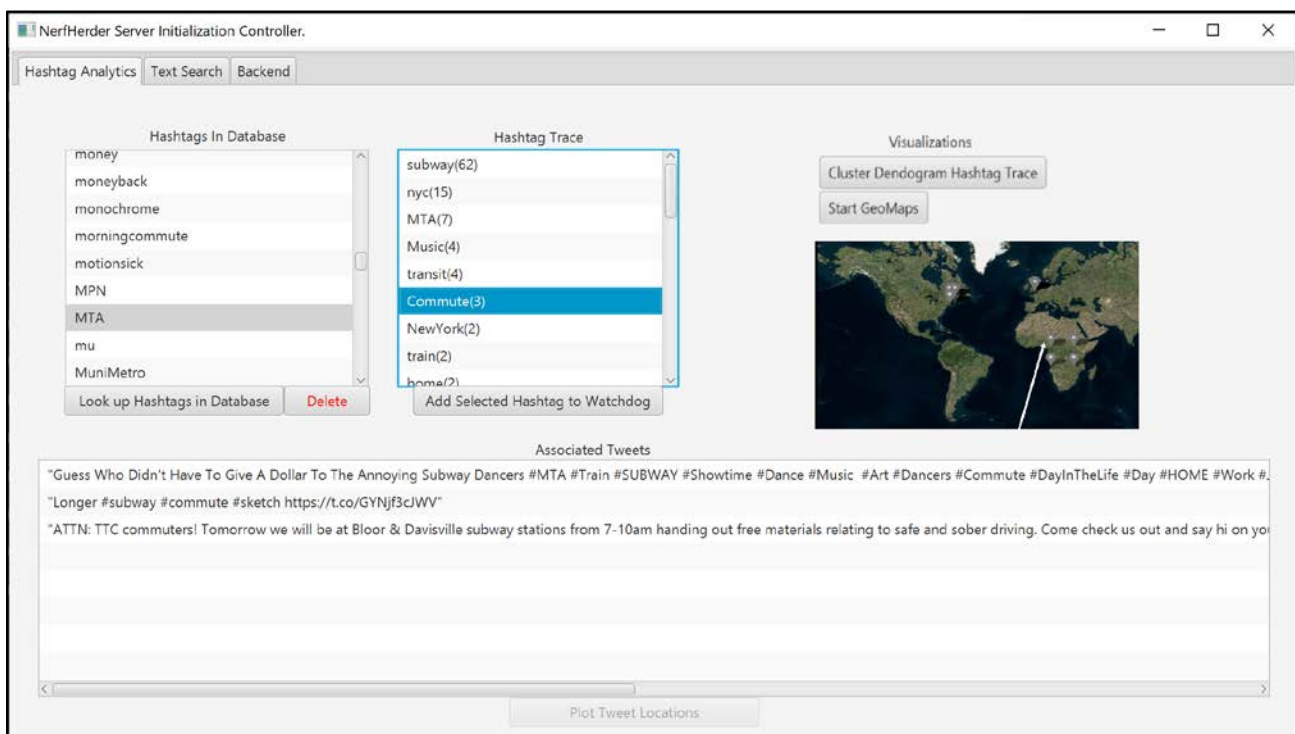


Figure 2-5 GeoMaps

<sup>ii</sup> This action was not executed by the developer during the demonstration.



## 2.2 SCOPE AND LIMITATIONS

The original objective was to conduct an operational field assessment (OFA) to provide first responders with the opportunity to interact with the NERFHERDER software and evaluate the software's functionality and suitability; however, based on guidance from the DHS S&T Office of General Council, to maintain compliance with Twitter's terms of service, the scope of the event was limited. Rather than conduct a conventional hands-on OFA using live data, the NERFHERDER developers conducted a technology demonstration using ExoAnalytics Solutions' hardware and user accounts and presenting only historical data. This data collection event included a component during which NUSTL gathered feedback from the evaluators on their impressions of the software capabilities demonstrated.

Throughout the demonstration, evaluators provided continual verbal feedback during each portion of the data collection event. Feedback was captured by the NUSTL data collectors and was analyzed for this report in Section 3.

## 2.3 DEVIATION FROM THE TEST PLAN

The following deviations from the data collection plan were noted:

- Only seven of the eight selected evaluators were in attendance
- The developer team did not add new hashtags to the database, instead they relied on pre-loaded hashtags.
- The developer team did not demonstrate how to remove search terms from Watchdog database.

## 3.0 RESULTS

Evaluator feedback was collected through three primary mechanisms. First, data collectors took notes on comments and questions posed by the evaluators as they observed the demonstration. Second, at the completion of the demonstration, evaluators were asked to complete a questionnaire to gauge their impressions of the technology and its suitability for their typical field operations. Lastly, an informal debrief conversation was carried out by the test director to solicit further feedback through conversation, capturing comments and thoughts that might not have otherwise been captured.

### 3.1 DEMONSTRATION QUESTIONNAIRE

The demonstration questionnaire contained a total of 14 questions. The first 10 questions allowed for responses to be captured in a five-point Likert scale format. Table 3-1 below illustrates the responses provided by the seven evaluators to the first 10 questions of the questionnaire. Boxes that are shaded indicate that at least three of the evaluators provided the same response.

Table 3-1 Questionnaire Results

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
The NERFHERDER user interface seemed intuitive and easy to use.			1	5	1	
The NERFHERDER display is easy to read and appropriate for my use (i.e., display, font size, button size, menus, options, modules, screens, selection capabilities).		2	1	4		
The tweet review appeared easy to interact with and understand.		2		5		
It was intuitive to confirm an event within NERFHERDER.			1	1	2	3
The features available in NERFHERDER are intuitive to use and would help in my daily tasks.			1	6		
The duration and detail of the training and set up for NERFHERDER was sufficient.			2	2		3
The set-up process to receive alerts and notifications was intuitive.				2	2	3
I was satisfied with the capabilities of NERFHERDER.				2	2	3
NERFHERDER is something I would actively use if it were available.				4	3	
NERFHERDER is something I would recommend for my agency to acquire.				3	4	



The first 10 questions were designed so that a response of “Strongly Agree” correlated with a generally positive impression of the technology, and a response of “Strongly Disagree” correlated with a generally negative impression of the technology. Based on this, further analysis was performed by mapping the Likert-scale responses to a numerical scale and using them as weights to arrive at a single value that represents the evaluators’ collective response for each question. Table 3-2 illustrates how the answer choices were mapped to numerical values.

Table 3-2 Mapping Responses to Weighted Values

Original Response:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Weight:	2	1	0	-1	-2

The formula that combines the weights above and the collective responses of the evaluators to a single value is:

$$\sum_{i=1}^5 (weight)(number\ of\ responses)$$

Where *i* is the actual response for that questions (i.e., strongly agree (1), agree (2), neutral (3), etc.).

Applying the weighted sum formula, above, to each of the 10 Likert-scale questions yields the summary results Table 3-2. In Table 3-3, a high negative score indicates that more evaluators generally “disagreed” with the associated statement, and a high positive score indicates that more evaluators generally agreed with the associated statement.

Table 3-3 Weighted Score Summary

Statements	Weighted Score
The NERFHERDER user interface seemed intuitive and easy to use.	-7
The NERFHERDER display is easy to read and appropriate for my use (i.e., display, font size, button size, menus, options, modules, screens, selection capabilities).	-2
The tweet review appeared easy to interact with and understand.	-3
It was intuitive to confirm an event within NERFHERDER.	-5
The features available in NERFHERDER are intuitive to use and would help in my daily tasks.	-6
The duration and detail of the training and set up for NERFHERDER was sufficient.	4
The set-up process to receive alerts and notifications was intuitive.	0
I was satisfied with the capabilities of NERFHERDER.	0
NERFHERDER is something I would actively use if it were available.	-10
NERFHERDER is something I would recommend for my agency to acquire.	-11

### 3.2 DEMONSTRATION DEBRIEF CONVERSATION AND OTHER COMMENTS

Throughout the demonstration, NUSTL data collectors captured questions and comments from the evaluators that indicate their impressions and reactions to the technology. An informal debrief was conducted at the end of the demonstration to further solicit feedback. The below list paraphrases the most salient comments of evaluators in a non-attributable manner:

#### Pros

- The hashtag stack-trace feature is unique and appears to be a useful analysis feature.
- This product can filter out a lot of “noise.”

#### Cons

- The start-up process is inefficient because it requires the end user to manually click through three unique start-up buttons.
- Geographical bounding for searches is not available.
- The software does not provide any type of alerts or notifications.
- There are too many windows that need to be open at the same time. There is a fear that accidentally closing one could cause issues during operation.
- The software is only compatible with social media feeds from Twitter.
- The set-up is difficult for the average user. The product appears to have been built for a coder.
- The software’s requirement to use Java may be burdensome for some departments.
- The workflow within the application is confusing. The user must switch between multiple tabs and windows.
- There is no ability to undo or “go back” within the application when using it.
- There is no link provided to the original tweet.
- Editing, adding and removing search terms is confusing.
- The refresh rate of data being pulled from Twitter is not easily accessible to see or edit.
- Upon start-up of the application, a Microsoft command line window is opened. This command line window that runs in the background adds visual complexity to the operation of the application.

The list below provides explicit suggestions for improvement from evaluators:

- Streamline the graphical user interface (GUI) [from multiple windows to just one] and automate more processes [such as the initialization process].
- The refresh rate (i.e., the rate at which NERFHERDER pulls information from Twitter) should be user adjustable.
- The software should indicate to the user when data was last pulled from Twitter with a timestamp.
- The ability to search within a specific geographical location should be added.
- The current map feature could have layers with additional information added to them.



## 4.0 CONCLUSION

Many of the evaluators indicated that NERFHERDER has useful features and can help them sift through vast troves of data to find salient information that can improve situational awareness; however, the application was not easy to learn or use. The capability provided by the application did not outweigh the burden on first responder organization of installing the software and training end-users to properly operate the application.

Evaluators articulated that changes to the GUI, such as minimizing the number of windows that are open and streamlining the workflow, and additional features, including incorporating a time stamp, searchability by geographic location and refresh rate adjustability, would make the application more suitable for their typical field operations.



## 5.0 WORKS CITED

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