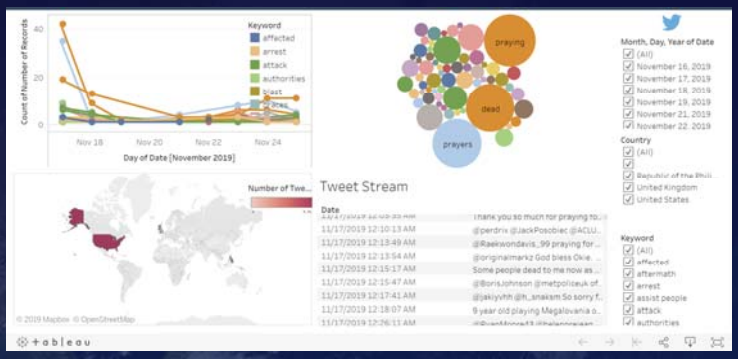
Crisis Monitor

Samraj Jeyachandran
Swapna Gupta
Aron Tharp
Savannah Edwards
Nawida Hussaini
Robert O'Dowd

A real-time dashboard to monitor worldwide crises so aid organizations, journalists, and supply chains could mitigate bodily or financial harm.



Motivation/Introduction

The software helps users identify political instability or crises where a population is in danger, briefly explain the crisis, and monitor it. We will quickly detect crises where a population is suddenly at risk of mortal peril by analyzing Twitter data. The application will be fed tweets captured in near real-time. End-users will interact with it through an intuitive visualization to monitor ongoing crises worldwide.

Currently, NGOs and governments provide historical or periodic reporting. They rely on manual efforts, are at risk of bias, and compromise on speed-to-market. Not having an accurate, up-to-date understanding of crises as they unfold is dangerous for those affected. They generally have narrower or local scope, whereas we seek to identify crisis globally. With 134 million daily active Twitter users, Tweets from all sources can be used to minimize bias and maximize firsthand data. Many organizations and individuals need to instantaneously know when crises occur and be able to respond immediately. Benefits include timely evacuations, quick police or military response, and minimal supply chain disruption.

Approaches

This project harnesses live tweets linked to crises. We then classify them using multiple algorithms & add situational context for each tweet. End-users access this data collected in real time, through an interactive dashboard to monitor and predict developing crises across the Globe. Using social media data for social good gives us global reach, rapid event detection, speed and diminished bias. The main advantages are:

- Faster event detection
- Unbiased
- Covers larger geographical area

Ongoing Execution

- Twitter ingestion module leverages the Tweepy library to listen to Twitter's live feed. 380 crisis related keywords retrieved from crisislex.org are used as filter, This data is read into a pandas dataframe.
- Filtered data passes through the model for data cleaning / appending, classification and prediction.
- These near-real time, processed tweets are stored in an Azure Sql database which connects to Tableau for visualization.

Algorithms

Natural language processing Related :

- Remove stop words from the tweet text using Natural language Toolkit (nltk library)
- Vectorize the tweets using Term Frequency - Inverse Document frequency (TF-IDF) by assigning weightage based on relevance of words leveraging the Sklearn library.
- Enhance the Tokenization step listed above by leveraging ngram range (2,3) feature to vectorize "pairs of words" as opposed to individual words to improve relevancy.
- Perform feature extraction from training data using the TF-IDF transform function leveraging Sklearn feature extraction library.
- Extract situational context from tweets by using lemmatization and recognizing entities to be used in visualization. Spacy library was leveraged for this purpose.

Text Classification Related:

- Naïve Bayes, Support Vector Machine and Random Forest classification Models trained using Sklearn library
- Ensemble model to aggregate predictions from classification models and improve prediction accuracy.

Experiments and results

- We first used the Training dataset from crisislex.org, but it didn't give us enough negative data.
- So we manually annotated ~1000 tweets to add negative training data.
- Initially we tried word tokenization, but it didn't give desired results. So we submitted phrases to ngram.
- Since all tweets didn't have situational context, we had to add Lemmatization using Spacy library.
- We experimented with predictions from Decision Tree, Random Forest, SVM and Naïve Bayes models and landed on the ensemble model which provided the highest accuracy.
- Confusion matrix evaluated model performance using the test dataset and provided the accuracy score.
- AUROC method is used with the Naive Bayes algorithm to assign a confidence % for each tweet that was classified as crisis.

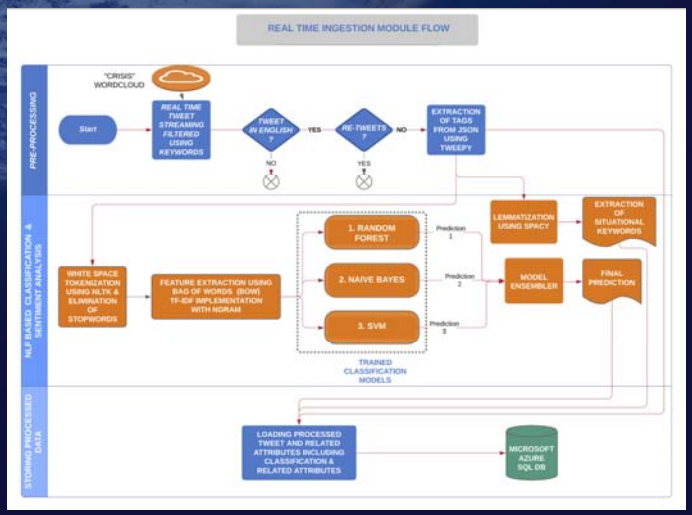
Visualization

Tableau connects to Azure Sql and extracts the analyzed, real-time temporal data to feed the dashboard. The Choropleth Map, by gradient, displays where the biggest crises are happening. The bubble chart shows the most popular keywords across crises tweets. The trend chart uses temporal data to depict evolution of crises. The tweet stream shows relevant tweets filtered by date range, country &/or keyword filters, and tooltips provide additional contextual details.

Users can set custom filters to only view information relevant to them.

Data

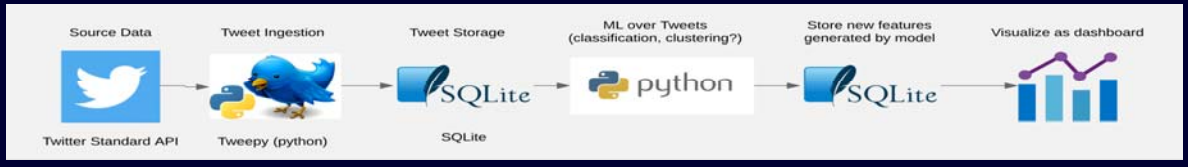
- 96 Percent — Crisis related Tweets identified
- 100 Hours — of Tweets captured
- 380 Keywords — Used for Filtering Tweets
- 5 Thousand — Features classified
- 36 Categories — of Crisis Analyzed
- 161 Thousand — Raw Tweets Captured



Prediction Accuracy

Random Forest	SVM	Naïve Bayes	Ensemble
95.6%	95.6%	95.2%	95.8%

Proof Of Concept / Research Method:



Production / "At Scale"Method:

- Mobile Friendly
- Offline Viewing
- Email Notification Alerts

96k Raw Tweets classified

25k Crisis-related Tweets ingested

EVERY DAY