

Abstract

Social media platforms, such as Twitter, serve as primary sources of information during emergencies and natural disasters due to their cost-effectiveness and efficiency. Locals and eyewitnesses often share critical situational data, including locations of damaged sites and areas with urgent needs like food and medicine. Extracting geolocation information from these posts is essential for effective disaster management, aiding response authorities in planning rescue activities and evacuating affected individuals. This study compares three transformer-based models (DeBERTa, BERT, and RoBERTa) for automatically extracting location mentions from disaster-related tweets, aiming to support response authorities in timely and accurate disaster management.

Problem Definition

The LMR task, as shown in Figure 1 below, is formally defined as follows: Given a tweet t that is related to a disaster event e , the LMR system aims to identify all location mentions (LMs): $LM_t = \{lm_i ; i \in [1, n_t]\}$ in the tweet t , where lm_i is the i^{th} location mention and n_t is the total number of location mentions in t , if any. It is also known as location extraction or geoparsing.

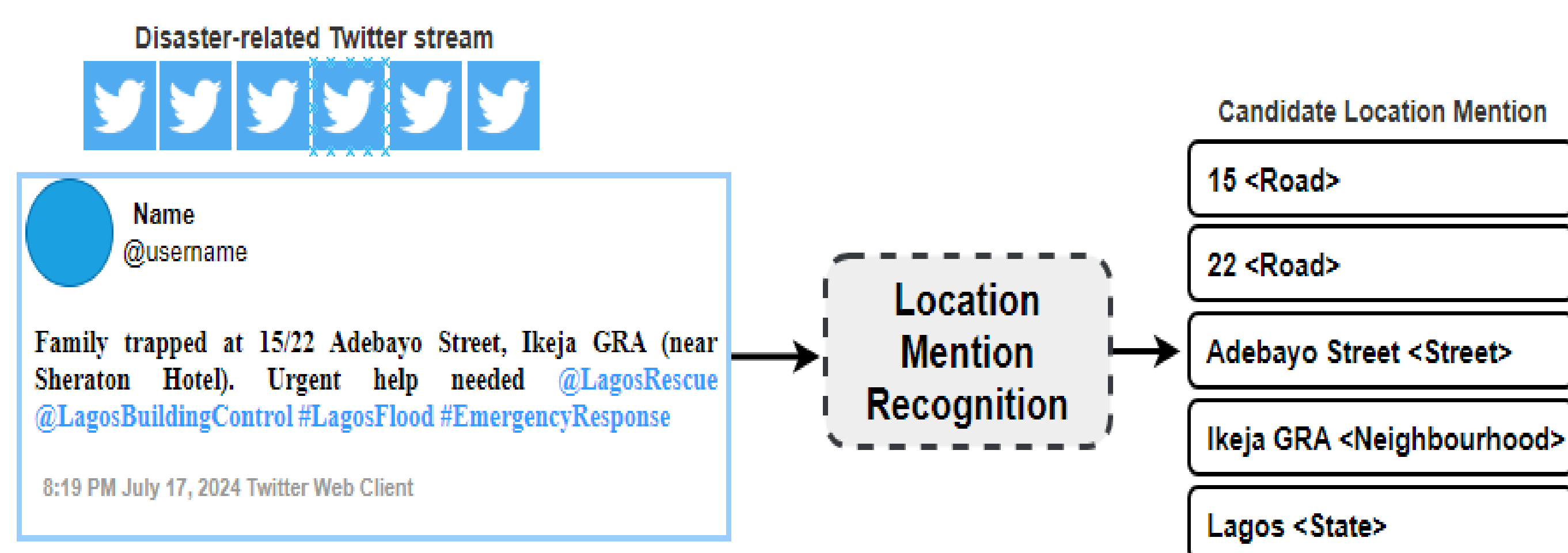


Figure 1: Location Mention Recognition Task

Experimental Data

The dataset used in this project, IDRISI-RE, is the largest and most comprehensive human-labeled English microblogging dataset available for disaster response research. The dataset consists of human-labeled posts from 19 diverse disaster events, capturing critical periods and spanning wide geographical areas. Each post includes annotations of location mentions and their specific types (e.g., country, city, street), making it an invaluable resource for training and evaluating automated systems for Location Mention Recognition (LMR) in disaster management.

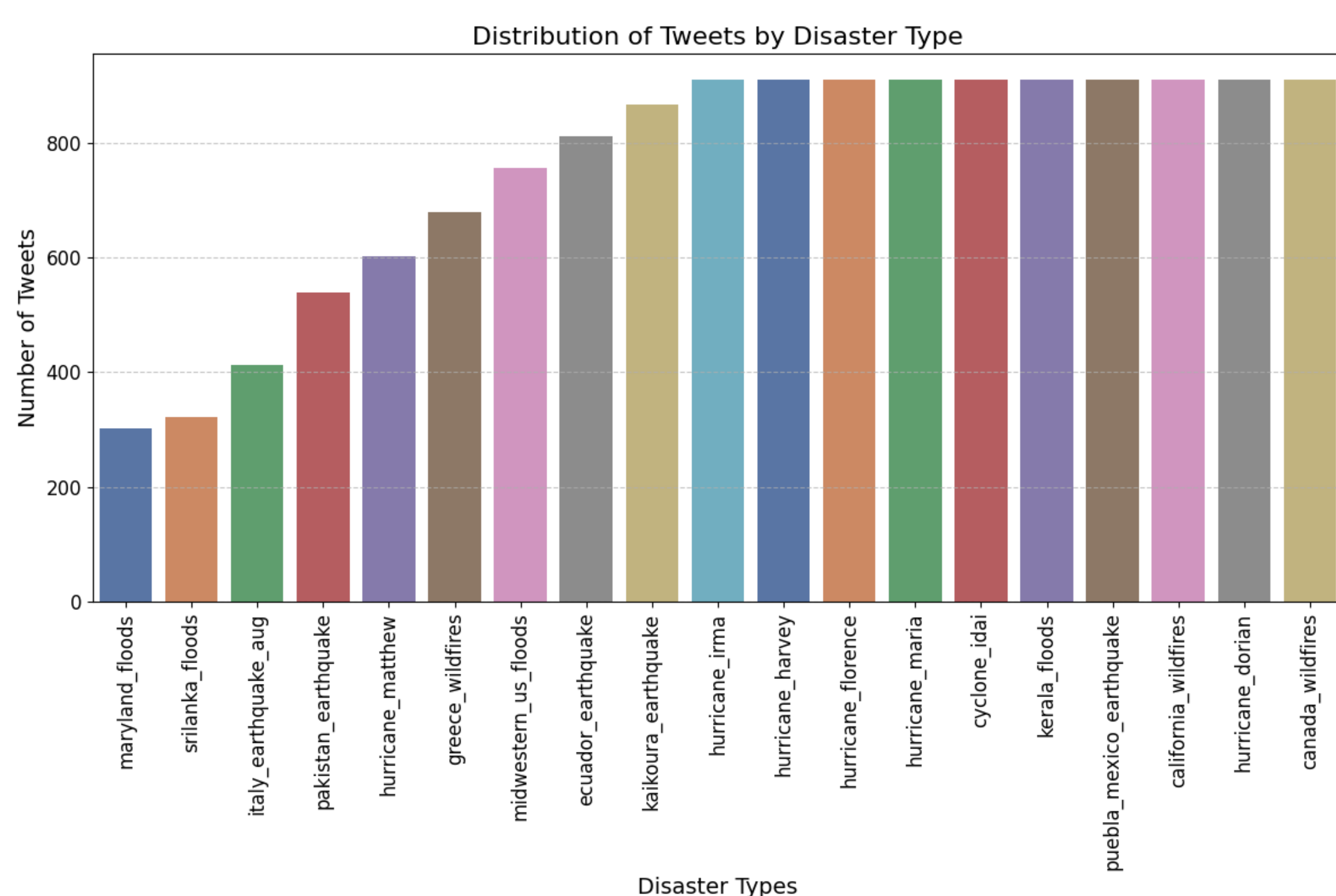
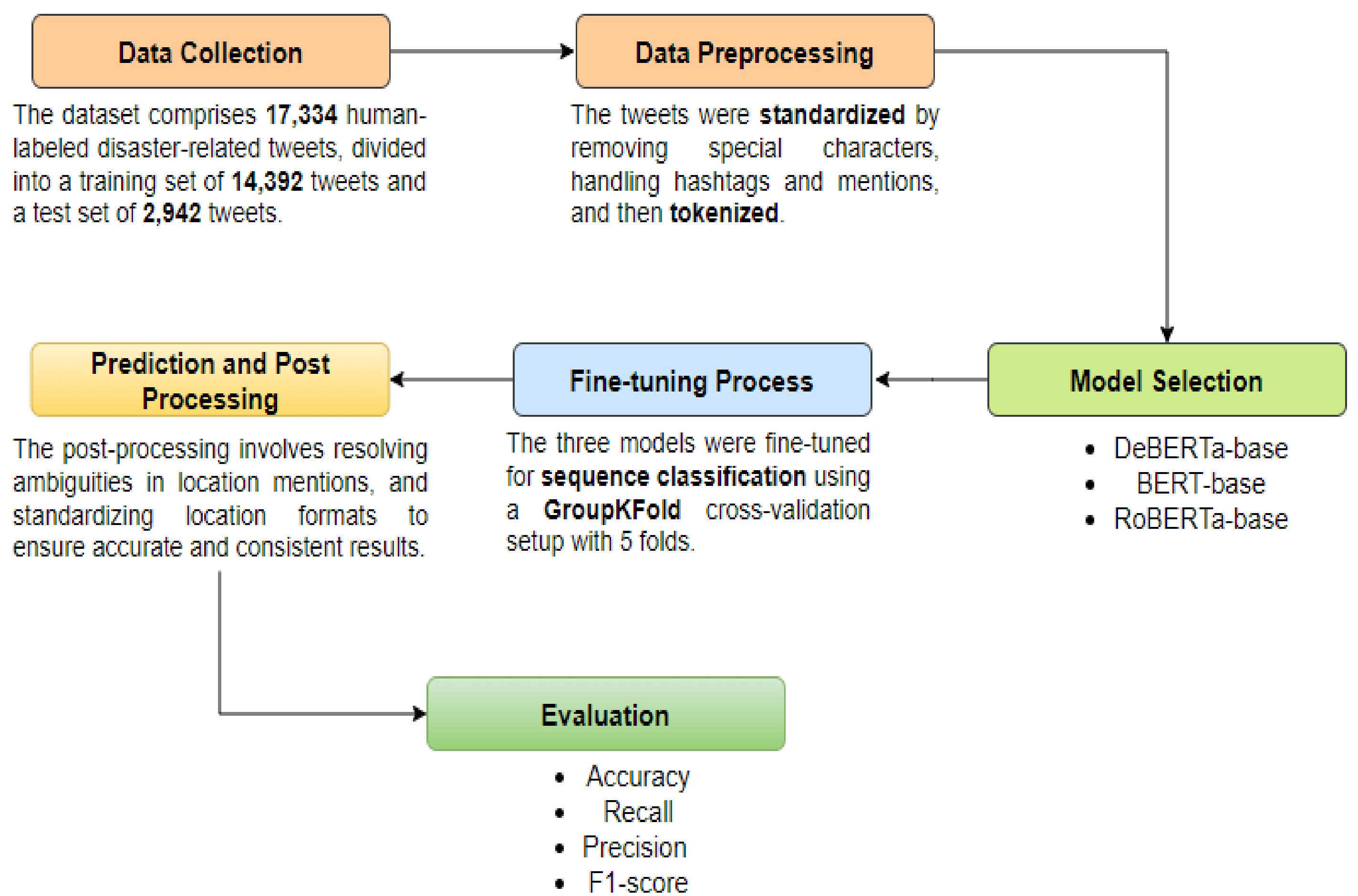


Figure 2: Distribution of Tweets by Disaster Type

Methodology



Results

Table 1 shows that DeBERTa-base outperforms both BERT-base and Roberta-base across all metrics for extracting locations from disaster tweets. DeBERTa-base achieves the highest accuracy, precision, recall, and F1-score, compared to the other two models, demonstrating its superior ability to correctly identify location mentions.

Table 1: Performance Summary of the Pretrained Models

Model	Accuracy	Precision	Recall	F1-Score
DeBERTa-base	97.73%	78.14%	88.64%	83.06%
BERT-base	97.50%	76.89%	86.13%	81.25%
RoBERTa-base	97.63%	77.82%	87.14%	82.22%

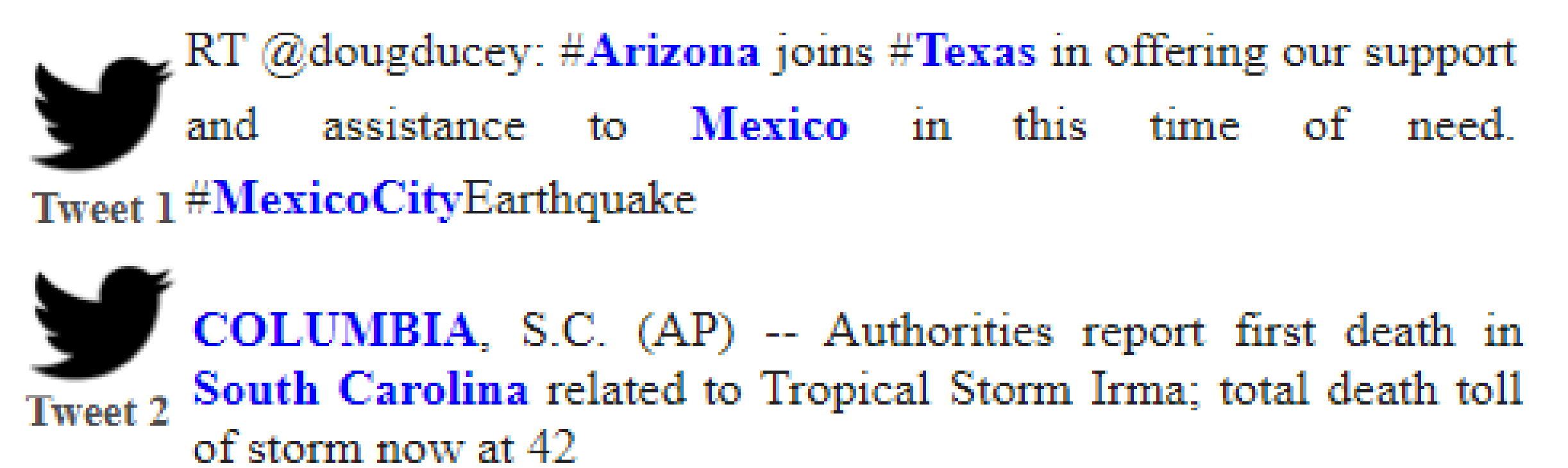


Figure 3: Sample Predictions from DeBERTa-base Model

Conclusion

This study demonstrates the effectiveness of transformer-based models in extracting location mentions from disaster-related tweets, which is crucial for timely and accurate disaster management. The comparative analysis highlights that while all three models significantly aid in improving situational awareness for response authorities, DeBERTa exhibited a slight edge in terms of accuracy and efficiency.

References

- [1] Suwaileh, R., Elsayed, T., & Imran, M. (2023). IDRISI-RE: A generalizable dataset with benchmarks for location mention recognition on disaster tweets. *Information Processing & Management*, 60(3), 103340.
- [2] Suwaileh, R., Elsayed, T., Imran, M., & Sajjad, H. (2022). When a disaster happens, we are ready: Location mention recognition from crisis tweets. *International Journal of Disaster Risk Reduction*, 78, 103107.
- [3] <https://tungmphung.com/a-review-of-pre-trained-language-models-from-bert-roberta-to-electra-deberta-bigbird-and-more/>