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One-Stop and Low-Barrier: A GPT-Powered Crisis Mapping Solution for Emergency Responders

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Abstract:

Crisis crowdsourced mapping typically requires a rapid response to a large volume of information within a short time frame. If we can extract locations from the user-generated information, it will be very useful to have some corresponding responses to help those in need. Message content from social media is an ideal source for helping promptly pointing the specific locations where the disaster-related events occur. But how to process a large amount of text is also so challenging. Recruiting many non-expert volunteers to extract information and map the data manually is a possible solution, but the stress faced by volunteers in emergency scenarios may impact their mental health, which is also not good for the sustainability of crisis crowdsourcing mapping. Automate geoparsing and geocoding system is a solution to this.

In recent years, large language models (LLMs) have shown the potential of processing text data. Its ability to process natural language in real-time aligns with the urgent demands of disaster response scenarios, where swift information extraction is critical. The pretrained language models (PLMs) achieved significant progress and also reduced the amount of labelled data required to train the task-specific models (Kalyan, 2024).

Generative Pre-trained Transformer (GPT) model is an advanced natural language processing algorithm. The choice of the GPT model is predicated on its state-of-the-art performance in understanding and generating human-like text, making it exceptionally well-suited for parsing the nuanced and often unstructured language found in social media posts (Hu et al., 2023). It will help identify and extract locational data, explicit in the form of addresses and landmarks or implicit through contextual clues. This extracted information will then be processed through a geocoding system to convert textual location descriptions into precise geographic coordinates. Geocoding is the process of converting addresses to geographic coordinates, which is a fundamental function in geographic information systems (GIS) (Roongpiboonsopit and Karimi, 2010).

Online geocoding can greatly improve the feasibility of transforming information into location in crisis crowdsourcing. And it enables volunteers to work together via internet infrastructure without being physically present in the disaster area, which is also very important for providing more meaningful assistance (Zook et al., 2010). Automating the processes of geoparsing and geocoding could provide a solution. Nevertheless, existing systems often require extensive datasets for training and substantial time to fine-tune the models, making them less practical in urgent situations.

The motivation of this pilot study is to propose an easily deployed solution based on GitHub that helps extract and visualize locations automatically to unlock the potential for crisis crowdsourcing mapping using the messages from social media. Integrating existing mature large language models, such as the GPT model, with minimal or no training, along with geocoding tools like Google Maps, could swiftly assist crowdsourcing teams in visualizing geographical information from social media. To access the initial capabilities of the large language model in the given tasks, the processing procedures will be done in a zero-shot learning circumstance without any training or additional data. This integration allows more human resources to be devoted to subsequent tasks such as data verification and coordination, which rely more on manual effort. The outcome of implementation will be the development of a webpage that will interact with users' input to extract the information of locations and mark them to a map automatically to complete the crisis crowdsourcing mapping (see figure 1).

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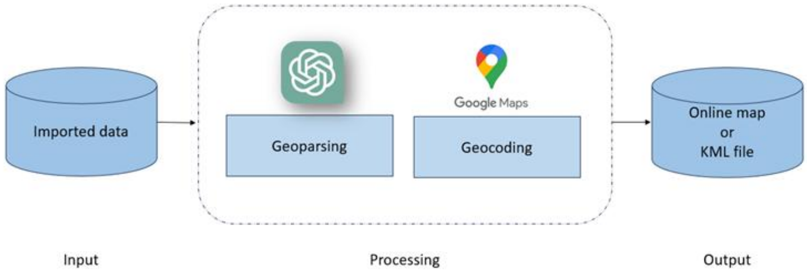

Figure 1. The workflow of the system design.

We have adopted two primary evaluation metrics for this study: processing time and match rate. These metrics will help us assess the efficiency and accuracy of the automated system in comparison to traditional manual methods. We evaluated the performance of two GPT models: GPT-4o and GPT-5. A total of 942 tweets were imported into the system for evaluation with each GPT model. The processing time recorded for GPT-4o was significantly shorter, at 674.4 seconds, compared to 972.2 seconds for GPT-5.

The accuracy of the models was assessed based on the number of matched markers—instances where the GPT-generated location matched the human-extracted location. Here, GPT-5 demonstrated superior performance with 863 matched markers out of 904, resulting in a match rate of 95.5%. In contrast, GPT-4o achieved a match rate of 89.5%, with 782 out of 874 markers matching the human-generated markers. Despite the longer processing time, GPT-5 model had a better performance on the quality of final output makers (see Table 1).

GPT model	Number of imported tweets	Processing time (s)	Number of markers	Mark rate (%)	Number of matched markers	Match rate (%)
GPT-4o	942	674.4	874	92.78	782	89.47
GPT-5	942	972.2	904	95.97	863	95.46

Table 1. The result of the evaluation

Additionally, semi-structured interviews with domain experts were conducted to evaluate the practical utility of the system's deployment and workflow. Two emergency response experts commended the "one-stop and low-barrier" philosophy, noting that the majority of their volunteers lack formal backgrounds in Computer Science or GIS and often struggle with the complexities of traditional GIS tools. They emphasized that such intuitive tools are essential for streamlining future volunteer training and operational readiness. To further validate these findings, usability testing was performed with 11 non-expert emergency response volunteers. After watching a brief two-minute instructional video, all participants demonstrated a rapid grasp of the tool's deployment and functionality. Most significantly, 83.3% of these users expressed a strong intent to actively integrate the system into their future crisis management workflows. These insights will further refine our understanding of the practical impacts and usability of the automated mapping system in real-world crisis scenarios.

References

Hu, Y., Mai, G., Cundy, C., Choi, K., Lao, N., Liu, W., Lakhanpal, G., Zhou, R. Z., and Joseph, K.: Geo-knowledge-guided GPT models improve the extraction of location descriptions from disaster-related social media messages, International Journal of Geographical Information Science, 37, 2289–2318, https://doi.org/10.1080/13658816.2023.2266495, 2023.

Kalyan, K. S.: A survey of GPT-3 family large language models including ChatGPT and GPT-4, Natural Language Processing Journal, 6, 100048, https://doi.org/10.1016/j.nlp.2023.100048, 2024.

Roongpiboonsopit, D. and Karimi, H. A.: Comparative evaluation and analysis of online geocoding services, International Journal of Geographical Information Science, 24, 1081–1100, https://doi.org/10.1080/13658810903289478, 2010.

Zook, M., Graham, M., Shelton, T., and Gorman, S.: Volunteered Geographic Information and Crowdsourcing Disaster Relief: A Case Study of the Haitian Earthquake, https://doi.org/10.2139/ssrn.2216649, 2010.

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