DISSERTATION PHASE 1

CA2 PRESENTATION

LLM-DRIVEN SUMMARIZATION OF FIELD NOTES AND GEOSPATIAL LOGS FOR DEFENSE INTELLIGENCE

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PROBLEM STATEMENT

Modern defense operations generate massive volumes of unstructured field notes and geospatial logs from diverse sources—UAVs, border patrols, surveillance devices, and frontline personnel. Analysts must manually extract actionable intelligence, often under time pressure and resource constraints, leading to delayed or inconsistent decision-making.

Despite India's 2023 Defence AI Roadmap emphasizing the use of AI/ML for decision support, there is no integrated system that can automatically interpret and summarize both linguistic and spatial military data.

Geospatial logs remain underutilized, and field notes often lack structure, making it difficult to generate quick, situationally aware summaries that combine "what happened" with "where it happened."

MOTIVATION AND BACKGROUND

India’s Ministry of Defence emphasized AI integration for surveillance, intelligence, and geospatial analytics in its official roadmap.

Defence operations generate vast, unstructured field notes and geo-tagged logs that analysts must process manually—slow, error-prone, and resource-heavy.

Recent advances (2024–2025) in Large Language Models (LLMs) and geospatially-aware AI enable automatic summarization of complex, mixed-format data.

No existing system combines natural language field reports with geospatial logs to produce actionable, real-time summaries for defence intelligence.

Objectives

01. A prototype AI system that converts raw military inputs into structured, domain-specific intelligence summaries.

02. A custom dataset combining geotagged field notes, map context, and simulated tactical logs.

03. Evaluation of multiple LLMs (e.g. Mistral, LLaMA2) for summarization, temporal ordering, and following instructions

04. A novel architecture combining geospatial analysis with NLP event reasoning

05. Practical relevance for defense command, public safety, and disaster response

Literature survey

S. N.	Title of Paper (with citation)	Methods / Models	Limitations	Dataset Used
1	*“Analyzing Textual Data for Fatality Classification in Afghanistan’s Armed Conflicts: A BERT Approach”* [1]	Fine-tuned BERT classifier on event descriptions to predict fatal vs non-fatal outcomes (Accuracy ~98.8%, F1 98.82%)	Focused solely on Afghanistan (Aug 2021–Mar 2023); limited generalizability; potential class imbalance not discussed.	ACLED
2	*“Task 2: Socio-political Fine-grained Event Classification using Fine-tuned RoBERTa Document Embeddings”* [2]	Fine-tuned RoBERTa on sub-event categories; macro F1 ~0.923, micro F1 ~0.932	Performance drop on out-of-sample event types; limited generalizability.	ACLED-derived sub-events
3	*“LEMONADE: A Large Multilingual Expert-Annotated Abstractive Event Dataset for the Real World”* [3]	Developed abstractive event extraction and entity linking tasks; compared LLMs and zero-shot retrieval (ZEST achieved F1 58.3%)	Zero-shot lags behind supervised models by 20–37%; complex multilingual integration remains challenging.	ACLED (reannotated subset)
4	*“A Model for Conflicts’ Prediction using Deep Neural Network”* [4]	Developed deep neural network for conflict event prediction; achieved ~89% accuracy on test set	Moderate drop from training (~98% to ~89%); limited discussion on overfitting; dataset span restricted to 2015–2018.	ACLED (2015–2018)
5	*“Predicting Social Unrest Events with Hidden Markov Models Using GDELT”* [5]	Built HMM-based sequence classifier using temporal burst patterns; outperformed logistic regression by 7–27% and baseline by up to 62%	Only applied to five Southeast Asian countries; HMM may oversimplify complex dynamics.	GDELT
6	The use of artificial intelligence in military intelligence: an experimental investigation of added value in the analysis process [6]	BERT-based NER (German) for entity extraction in military text	Rare entities misclassified; lemmatization errors	Military intelligence texts (German)

Research Timeline

- **2019**
  - Text Summarization with Pretrained Encoders
- **2020**
  - PEGASUS Abstractive Summarization
- **2023**
  - GeoLM: Geospatially Grounded LLM
  - AI Integration for National Security
  - BERT for Armed Conflict Fatality Classification
- **2024**
  - SmartBook: AI-Assisted SITREP
  - GeoLLM: Geospatial Extraction
- **2025**
  - OmniGeo: Multimodal Geospatial LLM
  - LEMONADE: Multilingual Abstractive Event Dataset
- **Explainable And Secure Summarization**
  - Integration with defense decision sytems
  - Multimodal Defense LLMs
  - Real-Time Situation Report generation

Methods Used in Literature

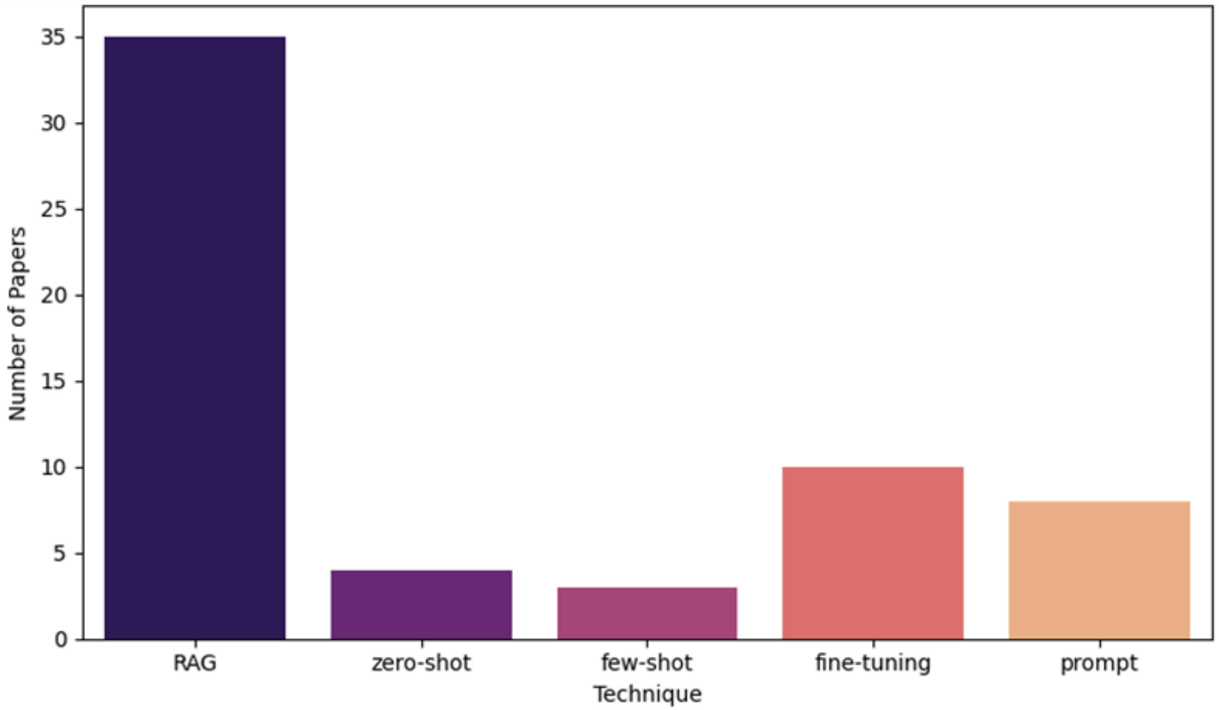


Fig: Summarization Techniques used

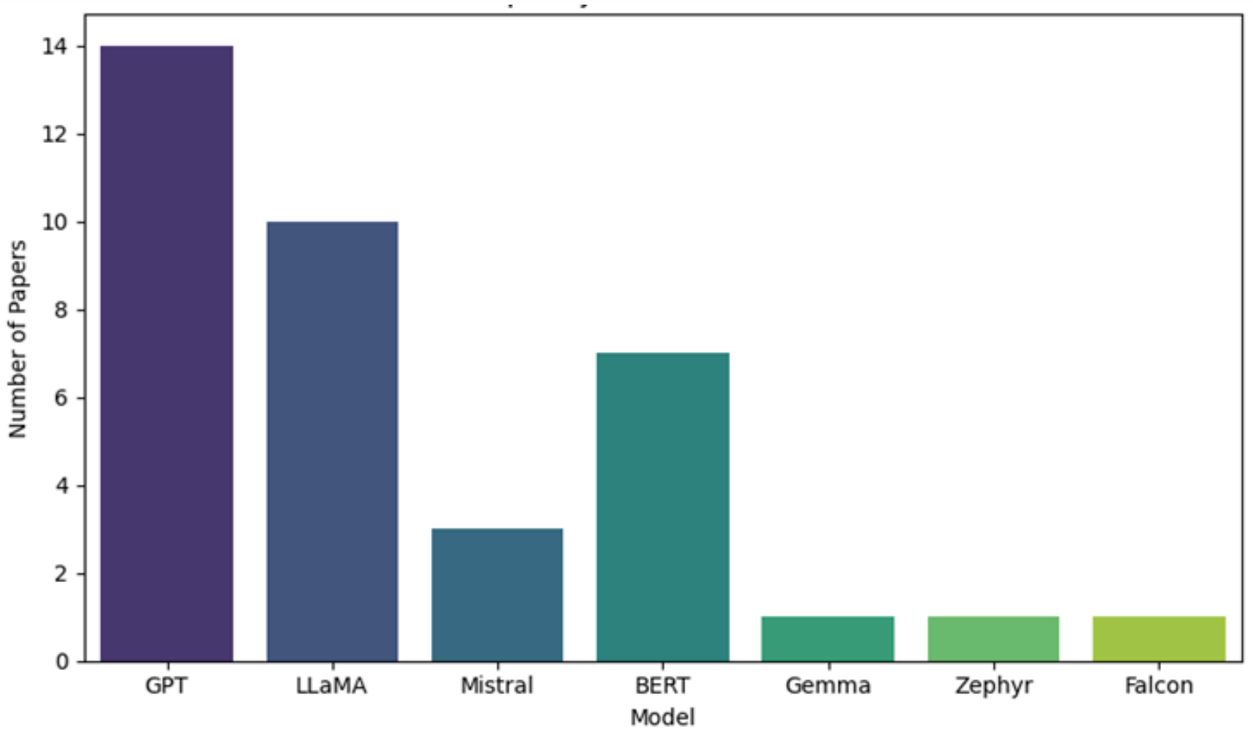
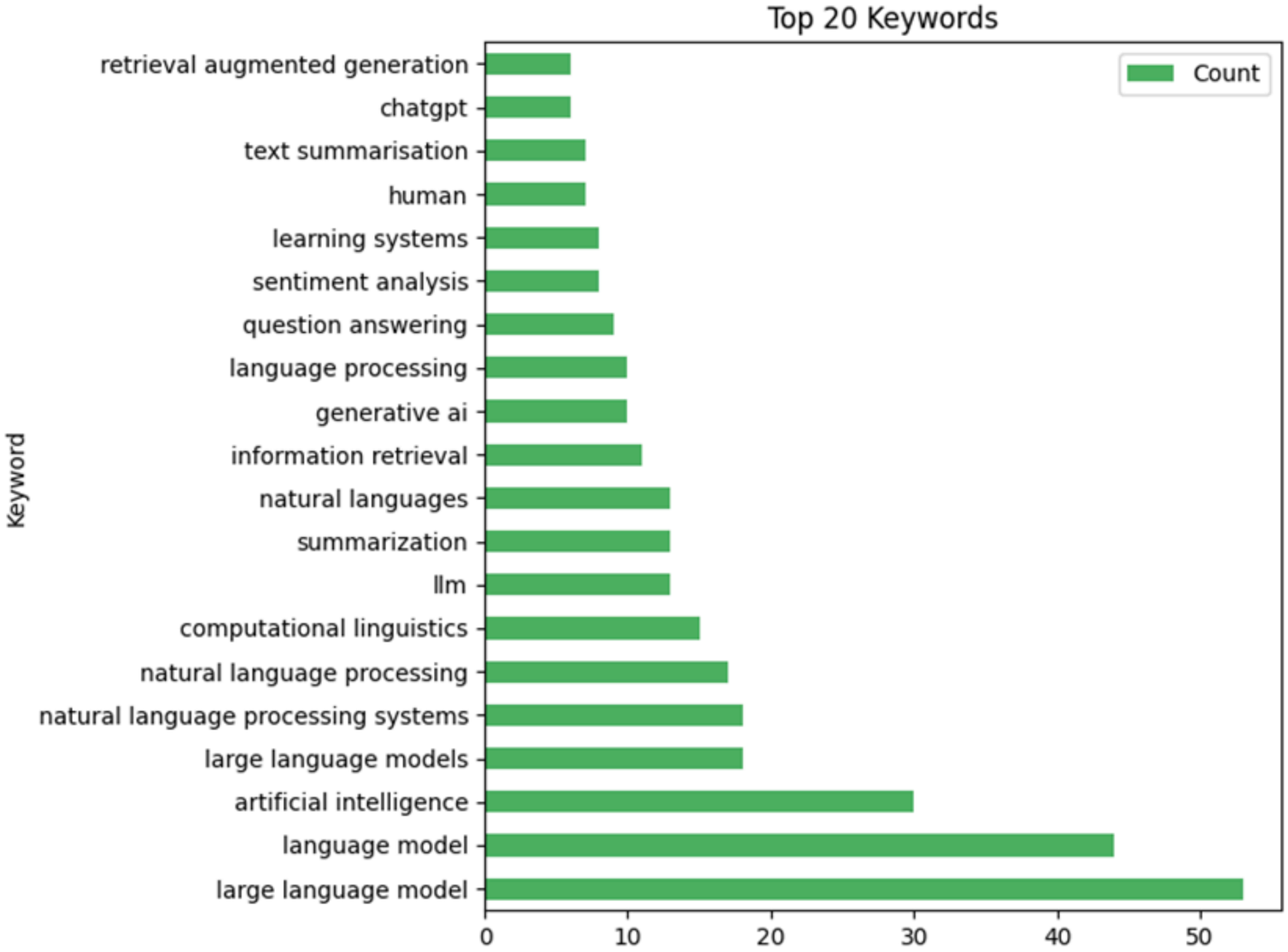
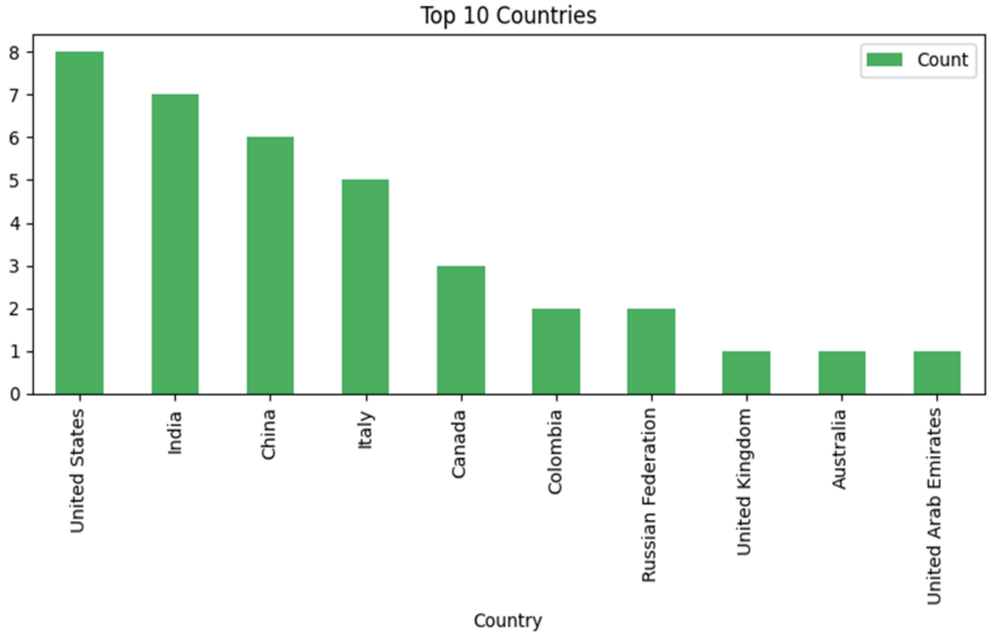
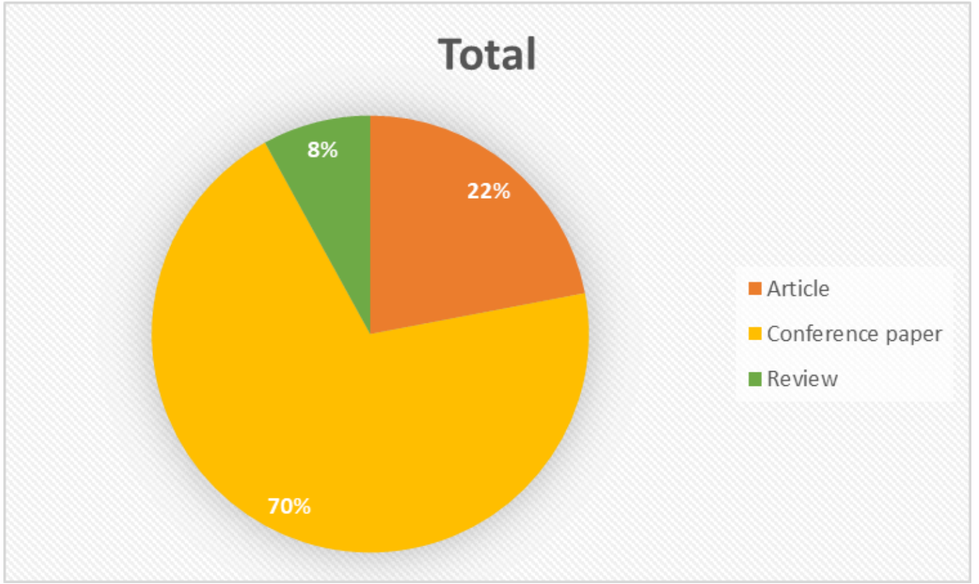


Fig: Frequency of LLM Models used

Bibliometric Analysis







PROPOSED METHODOLOGY

Data Acquisition

Input data
- Field notes or soldier logs (textual)
- Location coordinates (latitude, longitude, time)
- Optional: Map annotations, images,

Data Preprocessing

- Normalize timestamps
- Use reverse geocoding to convert lat/lon to place names
- NLP preprocessing: tokenization, sentence splitting

Named Entity & Event Extraction

spaCy, BERT-based NER--->

Entities: location, unit ID, enemy type, equipment
Events: engagement, movement, reinforcement, sabotage

Temporal & Spatial Sequencing

- Cluster events by time and location proximity
- Use graph-based or transformer-based encoders to build temporal flow
- Identify linked incidents

LLM-Based Summarization & Cue Generation

Fine tune LLM(Mistral, LLaMA2, GPT-4)
Generate INTSUM (intelligence Summary)

- location
- Time
- key findings
- enemy strength
- recommended action
- Add confidence scores

Evaluation

ROUGE, BLEU, or BERTScore

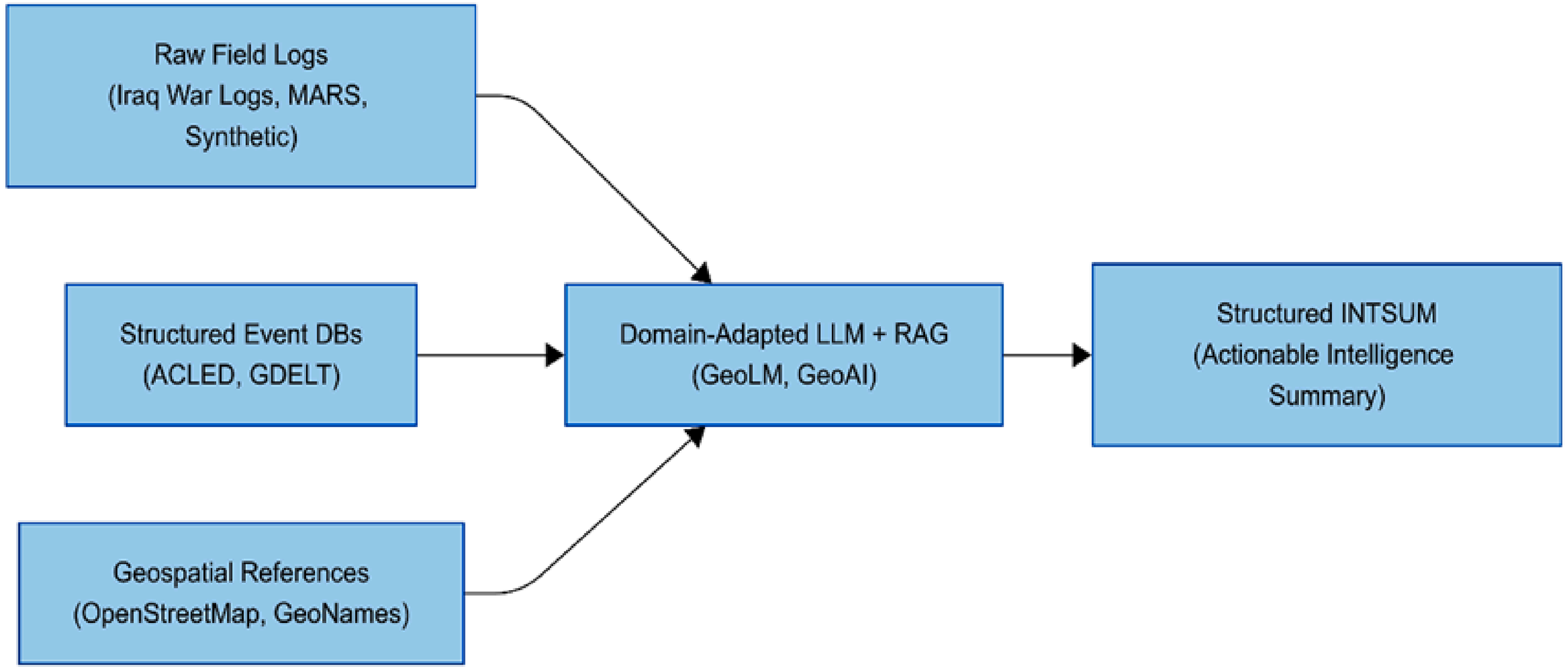
Agent Role	Responsibility
GeoSearch Agent	Takes an event's lat/lon + date → Queries the **Catalog API** for Sentinel-2.
Download & Preprocess Agent	Downloads satellite imagery, crops to event AOI, generates RGB.
OCR / CV Agent	If images contain embedded labels (from UAV), extract relevant info.
LLM Synthesis Agent	Combines ACLED notes + image summary → Generates structured **INTSUM** report.
Evaluator Agent	Checks whether generated reports are consistent and coherent.
Action Recommendation Agent	Infers tactical or humanitarian recommendations based on reports.

DATASETS

- ACLED – Real-world conflict event data (with API support)
- Iraq War Logs – Kaggle
- MARS Logs – Wikileaks
- Simulated field logs (Synthetic Data generation)

Modality	Purpose
Field Notes (Text)	Capture unstructured observations, mission logs, and patrol narratives.
Geospatial Logs	Provide latitude, longitude, and timestamped event coordinates.
Optional Imagery	Include annotated maps or photos for contextual enrichment.

DATASET USECASE



TOOLS AND LIBRARIES

- LLMs: FLAN-T5, LLaMA2, Mistral, GPT-4 (instruction-tuned)
- Geospatial Tools: Geopy, Folium, OpenStreetMap API
- NLP Toolkits: spaCy, HuggingFace Transformers, NLTK

REFERENCES

1. H. Mohammadi et al., “Analyzing Textual Data for Fatality Classification in Afghanistan’s Armed Conflicts: A BERT Approach,” Oct. 2023.
2. S. Kent and T. Krumbiegel, “CASE 2021 Task 2: Socio-political Fine-grained Event Classification using Fine-tuned RoBERTa Document Embeddings,” 2021. [Online]. Available: https://acleddata.com/data-export-tool/
3. S. J. Semnani et al., “LEMONADE: A Large Multilingual Expert-Annotated Abstractive Event Dataset for the Real World,” Jun. 2025.
4. O. B. Olaide and A. K. Ojo, “A Model for Conflicts’ Prediction using Deep Neural Network,” 2021. [Online]. Available: https://data.world.
5. F. Qiao, P. Li, X. Zhang, Z. Ding, J. Cheng, and H. Wang, “Predicting Social Unrest Events with Hidden Markov Models Using GDELT,” Discrete Dyn Nat Soc, vol. 2017, pp. 1–13, 2017, doi: 10.1155/2017/8180272.
6. C. Nitzl, A. Cyran, S. Krstanovic, and U. M. Borghoff, “The use of artificial intelligence in military intelligence: an experimental investigation of added value in the analysis process,” Frontiers in Human Dynamics, vol. 7, May 2025, doi: 10.3389/fhumd.2025.1540450.

THANK YOU