Smart Technologies for Emergency Response and Disaster Management

Chapter 5
Processing Big Data for Emergency Management

Introduction

- Reducing the impact of disasters and improving emergencies management; a global goal
- Decision making in emergency situations
- Big data
- Large amount of data and sources

2. Big data and emergency cycle

- Big data increasingly important in EM
- Emergency communication goal
- Data gathering during the emergency cycle

Phase	Description	Data Type	Example Data Sets
Pre-emergency (Prevention and Preparedness)	Avoid an incident or intervene to stop an incident from occurring and encompass actions that involve a combination of planning, resources, training, exercising, and organizing to build, sustain, and improve operational capabilities. In this phase governments, organizations, and individuals develop plans to save lives and minimize emergency damage.	User-generated	Twitter (food emergency, earthquake), web traffic (Flu)
		Sensor	Precipitation (PERSIAN, TRMM), evapotranspiration, soil moisture, temperature, vegetation density and water content (MODIS, LANDSAT), groundwater levels (GRACE)
During emergency (Response)	Include immediate actions to save lives, protect property and the environment, meet basic human needs, and preserve business operations.	User-generated	CDR, Flickr, Twitter
		Sensor	Imagery(LANDSAT, MODIS, Geoeye) thermal (LANDSAT, MODIS), radar (RADARSAT-1, CARTOSAT), spatial video
Post-emergency (Mitigation, Recovery)	Design recovery programs to assist victims and their families, restore institutions to suitable economic growth and confidence, rebuild destroyed property, and reconstitute government operations and services affected by emergencies. Recovery activities continue until all systems return to normal or better.	User-generated	CDR, emergency call content, Facebook
		sensor	Night-time Lights (NTL), Imagery, thermal, Radar, spatial video, Temporal Flood Inundation Mapping (GIEMS)
		institutional, public	GCM (Global Climate Model), Transportation data (subway, bikeshare), census, Worldpop, Open Cities

2.1 Challenges in big data and EM

- Opportunity to empower decision makers
- Challenges:
- Scale, granularity, ambiguity, accessibility, representation, and privacy
- Separating signal from “noise”
- Access to the data
- Representation of social media data
- Privacy and security
- Information - clear, quick and complete

2.3 Big data assistance before, during and after

- Pre-Emergency Phase
  - Prediction
  - Finding vulnerabilities
- During-Emergency Phase
  - Gathering information
  - Pushing information
- Post-Emergency Phase
  - Sharing information
  - Change of demands

3. Relevant research issues

- Quality of service
- Real-time service
- Reliability
  - Cloud storage
- Big data analysis algorithms

3.1 Security and privacy

- Filtering spam
- Real time mining of social media platforms
- Information sharing issues

3.2 Noise and Big social data

- intentional noise
- unintentional noise

4. Smart technologies and Big data

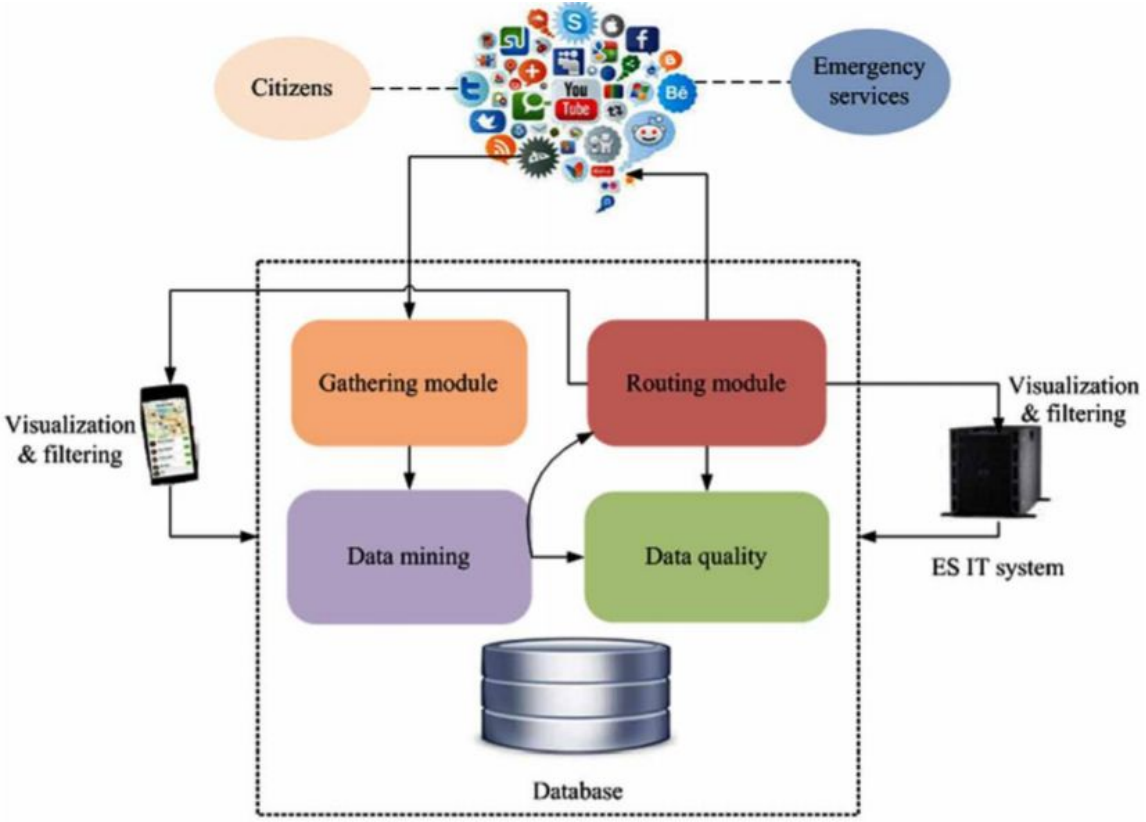
- Crowdsourcing
  - Communication between public and authorities
- Service and cloud computing
  - Collaboration and information sharing
  - Processed data
  - Data safety

5. Processing social media content

- diversity of different SM services and data formats
- standardize the exchange data format
- Some examples:

Project Name	Project Objectives	Social Media / Data Source	Approaches	Visualization components	Filtering mechanism	Possible Usefulness to our approach
Alert4All [3]	Alert4All aimed at improving the effectiveness of alert and communication towards the population in crises management.	Twitter, blogs	Classification, Support Vector Machine classifier	map	Keyword, tags	Usage of results, especially on how citizens trust information from EMS through different communication channels.
COSMIC[4]	COSMIC project is identifying the most effective ways in which new technologies and applications are being used by citizens and governments.	YouTube, Twitter, Facebook	Classification	list, recommendations and best practices	Topic, information	Mapping the use of current technologies in crises and also mapping the use of emerging applications. Usage of findings on the potential roles and ethics for citizen participation in emergency response.
CrisComScore[5]	The project developed an audit instrument as a tool for ensuring effective crisis communication strategies and implementation.	News media	Text processing	Text messaging	Topic, nformation	The auditing instruments for effectiveness will be one possible measurement method in the analysis phase.
CRISMA[6]	The CRISMA project will develop a simulation-based decision support system, for modelling crisis management, improved action and preparedness.	Data from sensors	Priorisation, Optimisation of response, counter measures and preparedness	GIS based visualization, Real-time environmental data visualization	Information	The auditing of decisions in crisis management will be one possible measurement method in the analysis phase.
ESS[7]	The ESS project developed a common information management and communication platform for supporting the management and coordination of emergency operations.	Real-time sensor data (thermal, video etc.)	Spatial localization, Data fusion	Map, lists	Time, query	Analysis of state-of-the-art technologies for crisis discovery and management and application of existing data fusion methods for developing a data fusion and mediation system.
IDIRA[8]	IDIRA project is focusing on the interoperability of data and emergency procedures in response to large-scale disasters.	Geographic and attribute data, integration of sensor data	Text classification, map, lists	Geo-referenced Visualisation map	Topic, time, information	Methods and technical interoperability standards developed here will influence the integration aspects.
INDECT[9]	The project is developing threat detection tools and generation of data mining and information retrieval applications.	Weblogs, chats, news reports	Relationship mining, machine learning methods for behavioural profiling	Event model	Keyword, query	Consideration of methodologies and algorithms for data & event processing.

EmerGent IT-System



5.1 Data enrichment

- Improving the raw data
- Source-based data
- Computation-based enriched data

5.2 Semantic issues

- Sharing informations across platforms
- Coping with overload of data
- Standard format for structured data
- Cloud storage and computing

5.3 Data mining

- Unique challenges with regards to social media
- Data mining can expand our understanding of emergencies
- Natural Language Processing

5.4 Data quality issues

- One of the strongest barriers when using citizen generated content.
- Quality factors

Intrinsic dimensions	Contextual Dimensions	Representational Dimensions	Accessibility Dimensions
Believability Accuracy Objectivity Reputation	Value-added Relevance Completeness Timeliness Appropriate amount of data	Interpretability Ease of understanding Representational Consistency Concise representation	Accessibility Access security

- Challenge: providing accurate “score” for quality of data

5.5 Data Visualization

- High-level of visualization
  - Compact with small amounts of data
- Low-level of visualization
  - More detailed overview with large amounts of data