Information Technology enabled Tools for Strengthening Multi-Hazard Preparedness and Emergency Response

New Emergency Management in a Resilience Era Facing Health, Climate and Energy Challenges

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Date and slot of presentation to be filled in shortly

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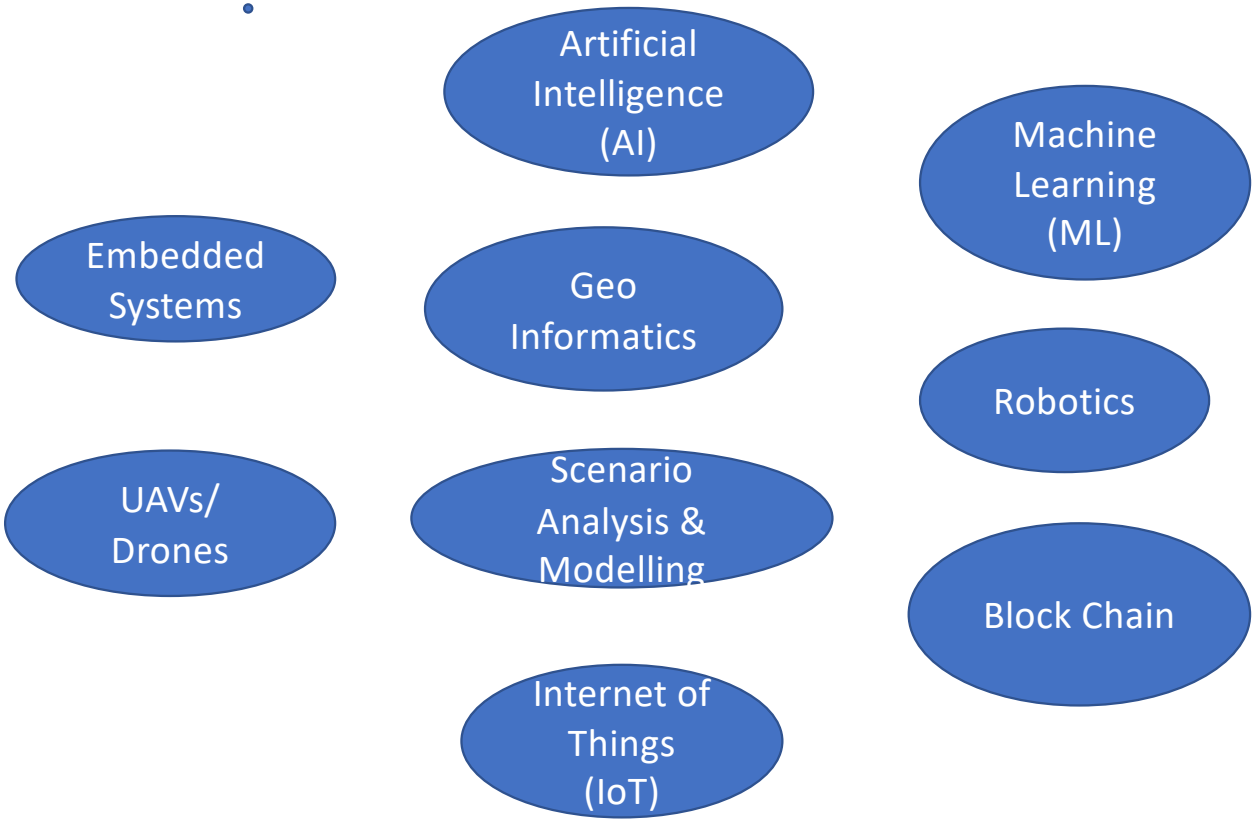
Outline of the Presentation

- Introduction
- Critical Gaps in Multi-hazard Preparedness and Response
- AI, ML and Block Chain Applications in Multi Hazard Preparedness and Response
- Big Data Analytics and IoT Applications in Multi Hazard Preparedness and Response
- Robotics, Embedded Systems and Drones in Multi Hazard Preparedness and Response
- Geo Informatics, Scenario Analysis & Modelling in Multi Hazard Preparedness and Response
- International cooperation and the Road Ahead

Introduction: IT Applications for Effective Disaster Management

- Information Technology applications have revolutionised the field of disaster management in the recent past.
- If power supply is disrupted during disasters like hurricanes, tsunamis or earthquakes, how will the first responders, NGOs, donors and government officials be able to overcome the constraints of lack of access to internet?
- “Social Sensing” offers the solutions through computing power using active and passive sensors in mobile phones, routers and other hardware interfaces.
- Can decentralised networks of local communities access the centralised networks parked on cloud platforms?
- Can a geo referenced network ping enabled phones, sensors and devices to locate exact locations of people in distress?

IT, ICT Ecosystem & Emergency Management



Edge Computing or Fog Computing

- According to Statista, the number of wireless devices connected worldwide has increased 29% from 14.96 billion in 2019 to 18.21 billion by 2020 and is expected to reach 22.2 billion wireless devices globally by 2021.
- Sensing devices like mobile phones, sensors, Radars, UAVs/Drones, Automatic Weather Stations (AWS) etc. can provide information which can help in improved preparedness and response.
- The network latency between sensors in mobile and wearable devices, users and apps to connect surveillance cameras, embedded sensors in pavements and in devices like cell phones, readers, and tablets can help in designing and implementing a generic software architecture with a central management function that resides in the cloud, a data processing element placed in the fog infrastructure, and a sensing component on the user's device.

Edge Computing or Fog Computing

- Data and image capture through survey questionnaires in mobile applications can collect information from disaster affected communities even when they do not have internet access and these data and images can be uploaded to the server on the cloud when the device reaches a location with WiFI or internet access.
- Fog based services can be tapped by dedicated vehicles which can travel to remote locations and access data from sensing devices and upload them to the cloud platform.
- Crowd-sourced data curating has become increasingly popular through shared tasks by multi-disciplinary professionals in remote and distant locations.
- Georgia Tech research teams have been working on social sensing solutions applying Edge computing or Fog computing to empower local communities to access distributed computing solutions in disaster-prone areas.

AI, ML & Block Chain Applications

- Google's Artificial Intelligence (AI) based Flood Forecasting System in India titled "Google Flood Forecasting Initiative" uses satellite imageries for analysing potential flood risk and for sending flood alerts and warnings to communities in flood prone localities.
- Low payload drones with cameras can reduce exposure to avoidable danger and injury for many professionals, including insurance claims surveyors, humanitarian assistance workers and risk assessment engineers. Drone surveys are cost-efficient, and can provide unique viewing angles that may not be possible by helicopters.
- Robots were used during the search and rescue operations in the World Trade Centre on September 11, 2001 to locate trapped victims under the collapsed structure.
- Machine Learning (ML) for predictive analytics modelling by monitoring the water levels in the rivers, rainfall patterns, course of the rivers, demographics in the catchment areas and river banks, etc.

Big Data Analytics & IoT Applications

- Data from satellite imageries, remote sensing, cadastral maps, digital elevation models, etc. can provide help in assessing disaster impact in disaster affected areas.
- Analysis of socio-economic and demographic data can help in identifying risk, vulnerability and exposure to weaker sections of the society like elderly citizens, palliative care patients, people with disabilities, etc.
- Open data efforts by the World Bank, United Nations and multilateral and bilateral donors have helped in several good governance initiatives by national and provincial governments.
- In the United States, agencies like FEMA, NASA, NOAA and federal enforcement agencies are using sensor data, LoRa devices, wireless radio frequency and satellite imagery to monitor the localities prone to hurricanes, earthquakes, tornadoes, tsunamis, etc.
- IoT networks of weather base stations in the Caribbean provide early warning alerts on hurricanes and tropical storms.
- Sensors on trees in drought situations can monitor the risk of forest fires.

Robotics, Embedded Systems & Drones

- In Mexico, Microsoft Azure supports SkyAlert, a mobile app, standalone devices and an IoT solution to provide alerts to citizens upto two minutes before an earthquake hits.
- Persistent scatter interferometry using Synthetic Aperture Radars (PSinSAR) can provide the interpretations and analysis of satellite imagery to track deformations in critical infrastructure like power, telecommunications, dams, airports, flyovers, etc. before, during and after sudden onset disasters like earthquakes, tsunamis, etc.
- Drones can help in reconnaissance, surveillance, damage assessment, detection and extinguishing wild fires, and assisting in Chemical, Biological, Radiological, Nuclear and Explosive (CBRNE) emergencies.
- Robots can help in search and rescue in disasters, assist in detecting short circuits and origin of fires and extinguish them and can also assist in responding to Chemical, Biological, Radiological, Nuclear and Explosive (CBRNE) emergencies.
- During the COVID-19 pandemic crisis, robots helped in non contact sanitising and in crowd management through innovative solutions by start up enterprises.

Geo Informatics, Scenario Analysis & Modelling

- Geo informatics solutions with spatial and thematic overlays of the geo morphology and hydro morphology of multi-hazard prone areas can help in scenario analysis and modelling to predict the impact of floods, cyclones, hurricanes, tsunamis, etc.
- Social media data on Twitter, Facebook, Instagram, LinkedIn etc. can be tracked for distress messages and requests for help. These can be tracked also on geo informatics platforms for providing real-time feedback through inter-operable multiple redundancy networks of first responder agencies.
- Climate change induced hydro-meteorological disasters and extreme events can be tracked on geo-informatics platforms and the satellite imageries and remote sensing feeds can be shared with first responder agencies before, during and after disasters to effectively prepare for, respond to and recover from disasters.
- Crowd-sourced efforts by multi-disciplinary professionals using geo informatics solutions, scenario analysis and modelling can help as force multipliers for saving lives and protecting livelihoods.

International Collaborations & the Road Ahead

- There is a greater need for international collaborations to bring multi-disciplinary professionals to search for solutions to address the pressing challenges facing humanity.
- COVID-19 pandemic has exposed the fragility of human lives and the threat to livelihoods because of the inadequate access to health care and the inability to pre-empt the outbreak of such unforeseen shocks and prepare effectively through anticipatory governance.
- UNDRR's Global Platforms for Disaster Risk Reduction and the regional platforms have been bringing together humanitarian assistance practitioners from around the world to share experiences, best practices and work collaboratively in replicating solutions to save lives and protect livelihoods.
- The e-Yantra initiative of IIT Bombay (e-yantra.org) brings students of educational institutions like engineering colleges in India and abroad to identify problems and design solutions. See https://eyic.e-yantra.org/

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