A Socially-Aware Infrastructure for Community Resilience

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Tsunami Disaster
Theoretical Framework - organizational means

Bowtie Architecture

Initial Conditions

National Level

Provincial Level

Municipal Level

Community Level

Integration
Aggregation
Visualization
Interpretation
Redirection

Technical
Environmental
Resources
Organizational
Social

Data Collection

Data Analysis

Organizational Action

Fire, Police
Medical Facilities
Evacuation
Search & Rescue
Utilities

(1)

(2)

(3)

(4)

(5)

(6)

(7)

(8)

(9)

(10)

(11)

(12)
Socially-aware Structure for Resiliency

Risk analysis → Database → Decision making → Government → Early warning information → Emergency plan → Service systems

Leaders → Followers
Oracle Application Service Database

Layers
- Layer1: Map data update by EOC
- Layer2: base map from ArcGIS
- Layer3: Leader path from CC
- Layer4: Twitter network

Tables
- Shelter
  - Schools
  - Mosques
  - Special buildings
- Personal data
  - EMS
  - Police
  - Fire men
- Health care
  - Government
  - Public
  - Private
- Infrastructure
  - Transportation
  - Bridges
  - roads
- WHOI
  - Format
  - Real/simulate
- BPPT
  - Processed Sea sensor data from BMKG

EOC
- Insert Update Delete

CRF
- Data Analysis Action

Map Service Feature service Network analysis

CC
- PF
- GIS
- SA
- <K,V>S

CASOS API

City level

Community level

SL
Architecture Model

- **Technologies**
  - GIS
  - Social media-Twitter
  - Raspberry PI based Opportunistic Routing network

- **Inter-governments and actors**
  - National--BMKG
  - Municipal- Emergency Manager
  - Community-Leader & Follower

Information flow
Information Dissemination

Raspberry PIs based OR network
Tsunami Alert and Evacuation
Tasks-User/Group/Token Authority

- Groups
  - Super Admin
  - Admin
  - Regular organization user
- Access Types
  - Admin-management
  - Risk report-insert
  - Maps-view
  - Layers-View/edit
    - Third part data-twitter
    - Multiple levels data-national/provincial/city/district
  - Analysis-risk analysis/network analysis
    - Safety evacuation path/closest facilities
    - Risk community
- Decision making
  - Send warning
# Data collection

<table>
<thead>
<tr>
<th>Lowest Jurisdictional Data ID</th>
<th>Entity category</th>
<th>Entity members</th>
<th>Source</th>
<th>Updated by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>Data Feed - Undersea Sensors</td>
<td>Sea Sensors</td>
<td>BKMG</td>
<td>Stream</td>
</tr>
<tr>
<td>Region</td>
<td>Data Feed - Land based Sensors</td>
<td>Seismic data</td>
<td>WHOI</td>
<td>Stream</td>
</tr>
<tr>
<td>City/Regency</td>
<td>Govt./Public Hospitals</td>
<td>Government Hospitals (beds, specialties, etc.)</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>City/Regency</td>
<td>Private Hospital</td>
<td>Private Hospitals (beds, specialties, etc.)</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>City/Regency</td>
<td>Infrastructure</td>
<td>Water, Electricity, Gas, Transportation, etc</td>
<td>Public/Private Orgs</td>
<td>Public/Private Orgs</td>
</tr>
<tr>
<td>City/Regency</td>
<td>Public Safety - Fire</td>
<td>Fire Apparatus and Personnel Data</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>District</td>
<td>Public Health Center</td>
<td>PH Centers (beds, specialties, etc.)</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>Sub District</td>
<td>Shelters</td>
<td>Schools, special buildings, mosques</td>
<td>HazardSEES Team</td>
<td>CC</td>
</tr>
<tr>
<td>Sub District</td>
<td>Public Safety - EMS</td>
<td>EMS Apparatus and Personnel Data</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>Sub District</td>
<td>Public Safety - Police</td>
<td>Police Vehicles and Personnel Data</td>
<td>HazardSEES Team</td>
<td>Simulator</td>
</tr>
<tr>
<td>Sub District</td>
<td>Data Feed - Twitter</td>
<td>Twitter feed of population density (1%)</td>
<td>Casos</td>
<td>API</td>
</tr>
<tr>
<td>SSD</td>
<td>Positions</td>
<td>Leaders and followers</td>
<td>CC</td>
<td>CC</td>
</tr>
<tr>
<td>SSD</td>
<td>Person Attribute</td>
<td>Attribute tables for leader special skillsets</td>
<td>HazardSEES Team</td>
<td>N/A</td>
</tr>
<tr>
<td>SSD</td>
<td>Person Attribute</td>
<td>Attribute tables for follower/leader special needs/conditions</td>
<td>HazardSEES Team</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Multi-threaded Service Infrastructure

- **Multiple threads** services - deal with many tasks at the same time.
  - Export the multiple thread service java into one Jar file -- MultiThreadService.jar, and it could be run like "java –jar MultiThreadService.jar"

- **Dispatchers** - distribute all requests to different services and send feedback response, write logs.

- **Services**
  - GIS services - map/feature/Network analysis
  - <K,V>S service - report/update/delete
  - Third parts services - CASOS Twitter, BPPT
Control Center

- **Service**
  - Information flow in Center Coordinator, PF, SA and GIS with MTS
  - Optimization of PF and SA
  - Notification/warning/alert from CC
  - \(<K,V>\)S modify-insert/update/delete—*redis*-server

- **Data**
  - Leader’s evacuation path in \(<K,V>\)S
CRF – Control Center

- Data
  - Visualization – map
  - Which layers show on left list.

- Analysis
  - Integrate policy design

- Actions
  - Different departments have different operations, based on the multiple levels of departments-national, provincial, municipal, community.
  - Dynamic data create/update/delete simulation-shelter attributes, hospital condition. Info from WHOI, BPPT and other departments.
  - Cooperation, coordination, control
Community communication

- **Data**
  - Multiple actors could report risk
  - Information format when info flow

- **Analysis**
  - Offline network analysis

- **Actions**
  - Leader broadcast evacuation path to his followers
  - Follower report risk to his leader
  - Leader double check follower’s risk report, and report to EOC
CC-CRF communication

- CRF+ Adapter in the same Server, CC in another Server
- Adapter setting web.xml to access any other service
- CRF Javascript send XMLHttpRequest to Adapter, Adapter redirect the request to target service, like CC, return response to CRF
Tasks – Multiple levels communication

- National
  - CRF
  - API
  - National CRF

- City
  - CRF
  - API
  - CC

- District
  - CRF
  - API
  - PI
Android studio+ arcgis android 10.2.7