SMART INDIA HACKATHON 2024

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Problem Statement ID – SIH1587

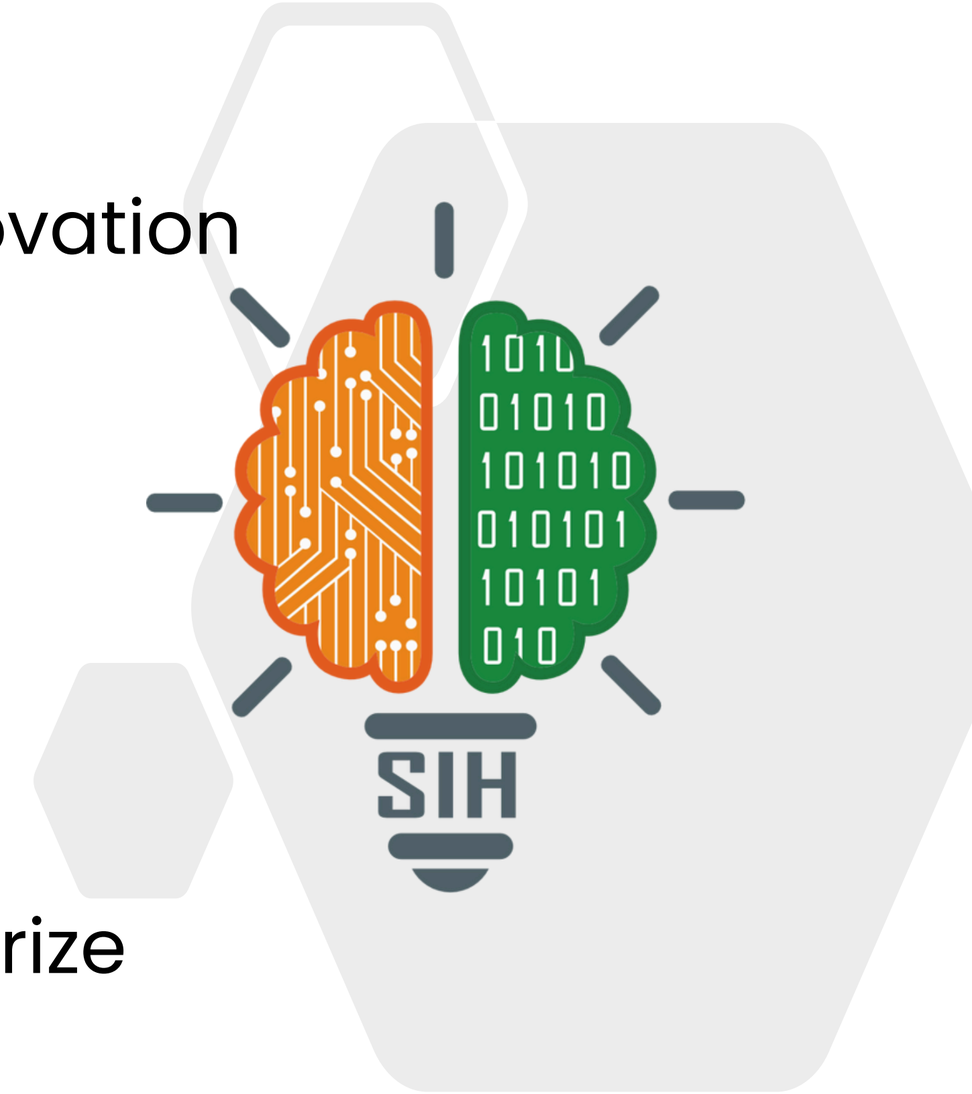
Problem Statement Title - Student Innovation

Theme - Disaster Management

PS Category- Software

Team ID- 289

Team Name (Registered on Portal) - Arize



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FORUS

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PROBLEM

Disaster management challenges stem from fragmentation, poor coordination, and delayed responses. In all phases—before, during, and after disasters—resources are inefficiently distributed.

Lives Lost, Millions Affected Source:UNDRR

79,732

People have lost their lives and **108 crore people were affected** in **321 incidences of natural disasters** in India.

Unseen Economic Drain Source:EM-DAT

$56 B

Economic loss from **321 natural hazard disasters** in 2023 affecting **93.1 million people.**

Lack Of a Unified System Source:NDMA

40%

of **disaster responses are delayed** due to **communication breakdowns** causing poor coordination among agencies.

Lack of Unified System

Internet Lost in Crisis Source: NBR

48 hrs

delay in the arrival of aid due to **difficulty in coordination** of logistics and **resource allocation without internet**

Broadcasting to donors Source: NBR

52%

public **distrust nonprofit organizations** due to **mismanaged funds** and ineffective leadership.

Balancing Supply and Demand Source: IFRC

4000 KG

of **delivered supplies are often unnecessary** for affected communities leading to **wasted resources**, according to IFRC

We provide a complete unified disaster management system, offering real-time coordination, resource tracking, and AI/IoT-driven relief strategies.

SOLUTION

Focused Operational Response Unified System (FORUS) enhances disaster preparedness, response, and recovery through AI and IoT-driven coordination and reliable communication systems.

Public App

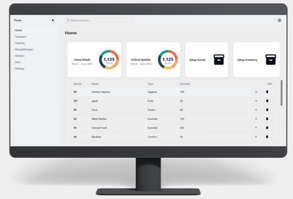
helps **people request aid**, **get updates**, and connect with others during disasters

Rescuer App

shows **requests from public**, which will be monitored by the camp software

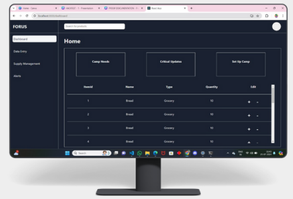
AI scans social media for disasters, **verifies them**, and supports immediate planning

Inventory Management Dashboard



gathers inventory data and uses **AI to track stock** and improve disaster response

Camp Management Dashboard



makes **supply requests easy, tracks the situation,** and helps **coordinate with authorities**

Dedicated Govt Dashboard : "Centralized hub for streamlining disaster response."

WHY WE STAND OUT ?

Unified Disaster Response System
Combines inventories, camps, rescuers and public for effective coordination

Social Media Based AI Disaster Response System
Uses 53 parameters to verify social media data and ensure accurate alerts

Secure Data Lake for Post-Disaster Analysis
Collects all post-disaster data in a secured repository for future analysis and reference

Scalable IoT Node for cross validation and safety
IoT nodes across various regions transmits regional changes in real time during disasters

TECHNICAL APPROACH

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Techstack

React.js, Flutter, HuggingFace, FastAPI, Socket.io, Express.js, PostgreSQL, Tensorflow, Docker, Flink, Bloc, Kafka, Python, Redux, Javascript, Firebase

BACKEND ARCHITECTURE

API GATEWAY

Postgres SQL
Centralised database for all servcies

The system uses Postgres SQL as a centralized database for all services.

PRISMA ORM
Type-safe database toolkit

SERVICES

LOCAL
- Camp Service
- Inventory Service
- IoT Service

CLOUD
- AI Service

LOAD BALANCER
Balancing load among services

Realtime-data streamlined via pipline to various services

Distributed search and analytics engine

Apache Kafka for Data Pipeline
Kafka clusters managed by zookeeper

Data from other apps ingested inside kafka bus

Kafka Gateway

API GATEWAY

A service-oriented architecture combines simplicity with modular flexibility, enabling effective tracking of supplies, efficient request management, and optimal resource allocation

Security
E2E, SSL, TLS, HTTPS
These protocols are designed to safeguard data integrity, confidentiality, and authentication across various networks and communications.

AI Components

- AI monitors social media for disaster updates
- SVM used to predict rainfall and chances of flood
- Alaska's GIS data tracks ground deformation via API
- Rule-based approach for pre-planning instructions
- AI verifies disaster data, enhanced by human input
- Hosting the module on Microsoft Azure for cloud infrastructure
- ML/Google Maps detect road blockages.
- **Tech Stack**: Tensorflow, FastAPI, Python, HuggingFace
- Utilizing Kubernetes for effective orchestration

SAF

FALLBACK MECHANISM

- **Internet** — Request is sent via internet
- **Offline** — store and forward
- **No network** — sent as data packets

VSAT

IoT Routing

Installed in each street of particular area

IoT

- GPS Module neo-6m
- Solar Panel & Hand crank Powered BMS for Efficient Energy Storage
- Mic & Speaker Module
- Oled Display & Keypad

Product Status
We have a 70% Working Prototype. Further build is on progress.
Testing and validation processes are next to be undergone

GOVT

- Centralised data lake
- Analyzing disaster data
- Realtime coordination of resources
- Public communication of disaster updates

Monitors

SAF

DISASTER

Predictable
- Cyclones
- Hurricanes
- Floods

Such disasters are often predictable by government agencies through advanced monitoring and forecasting systems

Un-Predictable
- Landslide
- Earthquake
- Tsunami

Such disasters are often unpredicable, giving authorities very little time to issue alerts

Stakeholder
GOVT (NDMA SDMA DDMA NDRF) · NGO · PUBLIC · MEDIA · CSR · CDBRM · NIBRM

DANGER DETECTING NODES

Tech Stack

Public App
Cross Platform

Flutter, Bloc, Firebase

- Emergency SOS option
- Real-time disaster alerts
- essential updates during emergencies
- monetization options during disasters

SAF

INVENTORY APP

The Inventory Management System optimizes resource use and ensures supply chain transparency in disaster response

Stakeholders: NGO/GOVT
Locations: Warehouses, factories etc...
Automated Inventory

Dashboard

- **Requirement tracking** — Tracks camp needs, allocates supplies, ensures secure data transfer.
- **Money management** — Money manager facilitates donations and aid allocation.
- **Quick routes** — AI ensures fast delivery by finding quickest routes to camps.
- **PDRS Output** — PDRS output displayed on the dashboard, hence providing real-time insights
- **Request & Response** — Camps request supplies; posts requests for visibility to both user app and inventory
- **Periodic updates** — Regular updates of remaining stocks by humans enhance coordination.

PDRS Result
- CAMP DETAILS
- SUPPLY DETAILS
- INTENSITY DETAILS
- CURRENT SOCIAL MEDIA POST
- CREDIBILITY OF NEWS

Money Manager
- Money Mngmt. using AI
- Realtime Allocation And Distribution
- Rule based Alg.
- Donation Allocation to camps

The camp web app **requests supplies** directly from the inventory system

SAF

SAF
The store-and-forward mechanism is a data transmission method where incoming messages are temporarily stored at an intermediate node before being forwarded to their final destination.

Tech Stack: React.js, Redux, Socket.io, Shadcn UI

Stakeholders:
NGO / SDMA / Public & Private Sector

The **camp web app** tracks **supplies**, **monitors requests**, and coordinates with authorities for efficient **resource distribution**

Camp App

Locations:
Schools, Hospitals, Govt. buildings

Rescuer App

Cross Platform

- Tasks based on real-time updates
- Tracks workers' locations, enabling quick response
- Receives urgent alerts

Tech Stack: Flutter, Bloc, Firebase

Dashboard

- **Camp overview** — Camp capacity, needs, and critical updates
- **Supply distribution** — Ensures fair supply distribution
- **Alert notification** — Receives urgent alerts via Public App
- **Camp management** — Manages inventory supplies within camps

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FEASIBILITY AND VIABILITY

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FEASIBLITY

Technical Feasibility

The architecture supports **seamless scaling** to accommodate **increasing data loads** and user demands **without major redesign**

Operational Feasibility

Integrating **Kafka and Flink** enables efficient real-time data processing and analytics for **faster, timely insights**

Economic Feasibility

Leveraging cloud-based solutions **reduces hardware costs** and leads to substantial overall savings, enhancing cost-effectiveness

Regulatory Feasibility

The system complies with disaster management regulations and data security laws like **GDPR** and the **Disaster Management Act**

Market Viability

The disaster preparedness system market is growing at an **8.5% CAGR**, reflecting sustained demand for our product as organizations prioritize safety and emergency response.

Authorities Involved

nidm Resilient India - Disaster Free India

SDMA

DDMA District Disaster Management Authority

UNDAC

CHALLENGES

Connectivity and Infrastructure

Can the software function reliably in regions with limited internet connectivity?

Collaboration and Coordination

How will it enable collaboration among Govt. agencies, NGOs, and private sectors?

Adoption and Acceptance

Will the solution overcome resistance and be widely adopted by diverse organizations?

Technological Literacy

Is the software user-friendly for ground-level responders, NGOs, and local communities?

Disaster Navigator

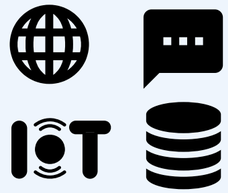
IoT, SMS, social media, and shared data to locate people in high-probability areas of danger

GOVT. SCHEME PMNRF

STRATEGIES

Yes, the software uses a 4-level fallback approach

- Storing requests offline and sending data packets via IoT nodes when connectivity is available

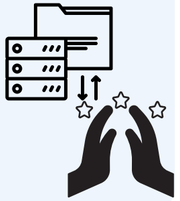


We provide a unified software system which enhances the collaboration

- Dedicated applications for government, NGOs, and the private sector, powered by Kafka and a unified data lake, ensure interoperability.

Our promotes collaboration and easy adoption without any bias

- A shared repository fosters widespread acceptance across diverse organizations.
- It operates under government supervision.



Its is not needed! - We reach you before you do using our disaster navigator

- Our system uses IoT nodes to monitor disaster-prone areas, providing real-time updates.
- It employs AI to verify disaster information from social media, all presented through a simple user interface.

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IMPACTS AND BENEFITS

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Economic Benefits

By optimizing resource allocation and reducing response times, FORUS can lower operational costs and prevent losses, offering substantial economic savings during and after disaster management.

Social Benefits

The system enhances coordination and speeds up disaster response, improving safety and reducing the emotional toll on affected communities by restoring stability faster.

Environmental Benefits

FORUS improves resource efficiency and reduces waste during disaster management, potentially minimizing environmental disruption and lowering emissions during recovery efforts.

STAKEHOLDERS & IMPACTS

Sample Scenario

PDRS actively scans social media & alerts immediate disasters

Camp management software monitors the rescuers current status

The rescuer quickly arrives at the affected area to offer assistance

Uses an IoT & app to ensure connectivity during disasters even no network

1 **INVENTORY MANAGEMENT**

Immediate Landslide
Identified using PDRS, goods are sent to camp

2 **CAMP MANAGEMENT**

Rescuer Deployment
Dispatches rescuers to the disaster site

3 **RESCUER**

Rapid Rescuer Response
The rescuer quickly arrives at the affected area to offer assistance

4 **PUBLIC**

Rescue and Relocation
Affected individuals were rescued and taken to the camp

Informed decision making and sudden planning

Effective management and migration of goods

Swift action and efficient resource distribution

Seamless coordination and deployment of rescuers

Timely aid and lifesaving interventions

Assesses the needs of the individuals and delivers

Government and Regulatory Bodies

- Enhanced transparency through a centralized portal for real time data
- Comprehensive analysis of post-disaster data to identify and insights

OUR PROMISE

Our solution perfectly aligns with the UN Sustainable Development Goals.

2 ZERO HUNGER · 3 GOOD HEALTH AND WELL-BEING · 13 CLIMATE ACTION · 17 PARTNERSHIPS FOR THE GOALS

India's Perspective

Government is highly committed to disaster management, allocating **₹10,000-₹15,000 crore in relief funds.** Ex: **₹11,500 crore** was allocated solely for **flood prevention in Bihar.**

***Consolidated Proof documents of all research is provided in slide 6**

PERKS

Our solution helps **NDRF and SDRF** plan effectively, reducing overhead, and increasing efficiency

10% → **Better** 30%

3 month Less recovery time

200+ Lives could be saved

24hrs of time can be saved

1000+Cr can be spent properly

25% increase in efficiency

30% reduction in resources

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RESEARCH AND REFERENCES

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DISASTER MANAGEMENT - RESEARCH & REFERENCES

India is highly vulnerable to floods, with over 40 million hectares of its 329 million hectares of land being flood-prone.

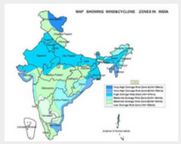
From 1996 to 2005, the average annual flood damage was Rs. 4,745 crore, compared to Rs. 1,805 crore over the previous 53 years.

The use of **big data and predictive analytics** in disaster management has been shown to improve early warning systems and disaster preparedness

Click here

Click here

An analysis of the frequency of cyclones on the East and West coasts of India between 1891 and 1990 shows that nearly 262 cyclones occurred (92 of these severe) in a 50 km wide strip above the East coast



Cyclone Category	Wind Speed in Km/h	Damage Capacity
1	120-150	Minimal
2	150-180	Moderate
3	180-210	Extensive
4	210-250	Extreme

The West coast saw 33 cyclones, 19 of them severe

Tsunami account for $280 economic loss

A review of available data from tsunami events puts these losses at 251,770 deaths and US$280 billion out of recorded economic losses for earthquakes and tsunamis of US$661.5 billion (1998-2017).

This compares with 998 deaths and US$2.7 billion in recorded losses from tsunamis over the previous twenty years

Click here

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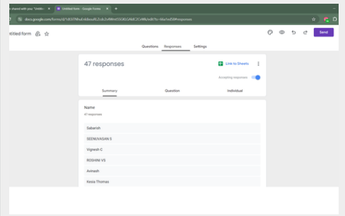
Disaster management and recovery is a complex, multi-tiered process that involves several different government and non-government organizations working in concert

Responses & Feedback from users



We **refined our solution** based on feedback from **47 users** through a Google Forms survey.

Based on our research, no existing software provides a unified platform for disaster planning and response management, acting as a shared repository for different organizations

CLICK ON THE IMAGES TO VISIT LINKS

Our Works

GitHub

You can see the Project files of FORUS here

Click here

Proof Documents

Consolidated proof documents of all the work

Click here

IoT - REFERENCES

Meshtastic

Implementation of LoRa mesh network

Click here

Free RTOS

Timely task management for embedded systems

Click here

AI/ML - REFERENCES

PDRS Social Media AI

Importance of monitoring social media during disaster

Click here

Tweet Cred

Identifying reliability of a tweet

Click here

BACK END

Kafka

Click here

Kafka's superior scalability sets it apart from other messaging systems

SOA

Click here

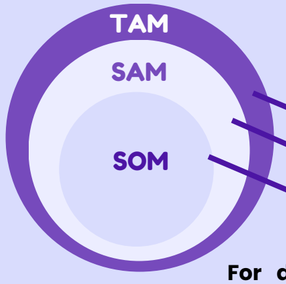
Service-Oriented Architecture enables modular, scalable, and flexible system integration

MARKET - RESEARCH

Market Growth

The disaster management market is projected to grow at a compound annual growth rate (CAGR) of 9.2% from 2023 to 2030.

India is one of the key geographical hubs for disaster management solutions, with significant investments and developments in this sector.



TAM - Total Addressable Market
SAM - Service Available Market
SOM - Service Obtainable Market

₹95,000 crore
₹30,157 crore
₹ 2,558 crore

For detailed market reseacrh and analysis check out Click here

Disaster Management Software Revenue Breakdown

Annual Cost to run the system per year = ₹57,024(For PDRS and Inventory) + ₹ 28,512(For Camp and Rescuer) + ₹30,240(PostgreSQL - m2) + ₹66,000(Data Transfer) + ₹216,000(Load Balancer, Azure Monitor and Backups) + ₹44,232(Azure Blob Storage) = ₹4,42,008/year

Profit Percentage

Software Sales: Profit margins on software (80%) due to centralized cloud infrastructure.
Hardware Sales: Profit margins on hardware (25%) due to sensor and network material costs.

DISASTER MANAGEMENT SOFTWARE - REFERENCES

India Disaster Resource Network (IDRN)

IDRN is a national web-based inventory of resources for disaster response

Click here

It helps local governments and disaster management teams track and mobilize essential resources like equipment, vehicles, and personnel during a disaster.

DLAN - DisasterLAN

It a web-based system for managing emergencies, offering real-time communication, workflow automation, and integration with FEMA's NQS. Used since 2002, it enhances response and reporting across the U.S. and Canada.

Click here