Final Year Design Project Showcase
Batch-2022
Year 2026

Department: Computer Science and Information Technology Programme: CSAI	
1	**Project Title** FLARE – An Intelligent System for Flood Forecasting and Early Warning in Pakistan
2	**Project Idea** Pakistan's recent floods (2022 and 2025, including the Gilgit-Baltistan and KPK disasters) exposed how outdated and static the country's existing flood-prediction systems are leaving citizens under-informed and unprepared. FLARE is an AI-powered web application that uses deep learning models along with real-time and historical hydrological/satellite data to forecast floods, generate live flood-risk maps, and issue early warnings to communities, disaster management agencies, and relief organizations while also connecting victims to shelters, verified NGOs, and a lost-and-found portal for missing persons/belongings.
3	**Process** The team-built FLARE using Agile methodology (weekly sprints) across five layers: ● **Frontend:** ReactJS, Tailwind CSS, Google Maps API for flood map visualization ● **AI Prediction Layer:** An LSTM model trained on WAPDA river discharge data and IMERG rainfall data forecasts river discharge up to 7 days ahead; this feeds a pixel-wise thresholding model (trained on Sentinel-1 SAR flood-extent maps) that classifies flood-risk zones ● **Backend:** Handles authentication, the missing-person portal, and system integration ● **LLM Layer:** Converts prediction outputs into readable newsletter-style reports for users ● **Database Layer:** Manages user/organization data, shelter data, lost-and-found records, and all model input/output data Model performance was evaluated using MAE, RMSE, and R^2 across 13 gauging stations (50,505 training samples).
4	**Outcome** FLARE successfully delivers a working flood forecasting and alert platform with real-time flood-risk maps, alert notifications, a lost-and-found portal, shelter-finding services, and NGO donation information. The system underwent full testing (unit, integration, system-level) with generally favorable, reliable results. The project also earned external recognition: ● Winner – FYP Extreme Module, PROCOM (FAST-NUCES) ● 2nd Place – Sindh IT Company Innovation Challenge ● Participant, STEM Talent Search Program

5	**Evidence (Theoretical Basis)** FLARE's design is grounded in reviewed academic literature on SAR-based flood detection, LSTM rainfall-runoff modeling (Kratzert et al.), Sentinel-1/Sentinel-2 fusion for inundation mapping (Konapala et al.), cross-modal distillation techniques (Garg et al.), unsupervised SAR change detection (Yadav et al.), and geospatial foundation models like Prithvi (Jakubik et al.; Li et al.). It also builds on Google's operational ML-based flood forecasting framework (Nevo et al., 2022), adapting similar LSTM + thresholding techniques specifically for Pakistan's under-served flood-prone regions.
6	**Competitive Advantage or Unique Selling Proposition** A benchmark comparison against Google Flood Hub, NASA GFMS, Copernicus EMS, and Pakistan's NDMA Disaster Alert app showed all four lack three features FLARE uniquely offers: ● Local NGO & Authority Integration – direct links to verified NGOs/relief organizations for donations and aid coordination ● Lost and Found Module – helps families locate missing persons/belongings after a flood, a gap in every existing system studied ● Community Interaction / Two-Way Communication – enables citizen reporting and engagement, not just one-way alerts
a	**Attainment of any SDG** FLARE contributes to three UN Sustainable Development Goals: ● **SDG 9 – Industry, Innovation and Infrastructure:** applies AI/deep learning innovation to a critical infrastructure gap (flood forecasting) ● **SDG 11 – Sustainable Cities and Communities:** helps city planning authorities avoid development in flood-prone zones and strengthens community disaster preparedness ● **SDG 13 – Climate Action:** directly addresses the increasing flood risk driven by climate change in Pakistan, helping mitigate its human and economic impact
b	**Any Environmental Aspect** By enabling smarter urban/infrastructure planning (avoiding repeated construction in flood-prone areas) and supporting climate-adaptive disaster response, FLARE reduces the hefty economic and environmental toll of recurring flood damage.
c	**Cost Reduction of Existing Product** FLARE minimizes dependence on manual flood monitoring using statistical models and post-disaster field assessments by providing automated flood-risk analysis from satellite and hydrological data. This allows authorities to deploy resources based on predicted impact, and avoid unnecessary operational expenditure.

d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggest) Pakistan's current flood forecasting relies largely on traditional statistical and rule-based methods, unlike FLARE's deep learning approach, and alerts are issued through manual, fragmented bulletins by agencies like WAPDA and NDMA that are often delayed and don't reach rural communities in time, with no coordination between forecasting, alerting, and relief efforts. FLARE improves this by replacing static statistical models with LSTM-based forecasting up to 7 days ahead, delivering real-time risk maps and alerts, and unifying alerting, shelter-finding, NGO coordination, and lost-and-found into one platform — cutting response time and improving overall disaster-response efficiency.
e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market The current flood-alert market in Pakistan is served by disconnected, single-purpose tools, including government bulletins, international platforms like Google Flood Hub or NASA GFMS, and standalone NGO or shelter directories, none of which combine forecasting, alerting, and relief coordination in one place. FLARE expands market share by consolidating these fragmented services into a single platform, making it the go-to solution for individuals, NGOs, and government agencies alike, and positioning it to scale beyond flood-prone regions of Pakistan into other disaster-prone areas across South Asia facing similar infrastructure gaps.
f	**Capture New Market** (e.g. Niche market or unaddressed segment) Existing flood forecasting systems primarily target government agencies or general populations, leaving a niche segment unaddressed: rural, flood-prone communities with limited access to real-time information, along with the NGOs and relief organizations trying to reach them efficiently. FLARE captures this underserved niche by offering a platform specifically designed for last-mile communication — connecting affected communities directly with shelters, verified NGOs, and a lost-and-found system — a segment no current major flood-forecasting product (Google Flood Hub, NASA GFMS, Copernicus EMS, NDMA) directly serves.
g	**Any Other Aspect** FLARE creates a modular architecture that also allows future integration of additional hazards (such as landslides or droughts), making it a scalable foundation for broader disaster risk management rather than a flood forecasting tool alone.
7	**Target Market** Flood-prone communities across Pakistan (e.g., Gilgit-Baltistan, KPK, Sindh) Farmers and rural households (crop/livestock protection) Disaster Management Agencies and government bodies (e.g., NDMA-type authorities) NGOs and flood relief organizations City/urban planning authorities General citizens seeking real-time flood alerts and safety information

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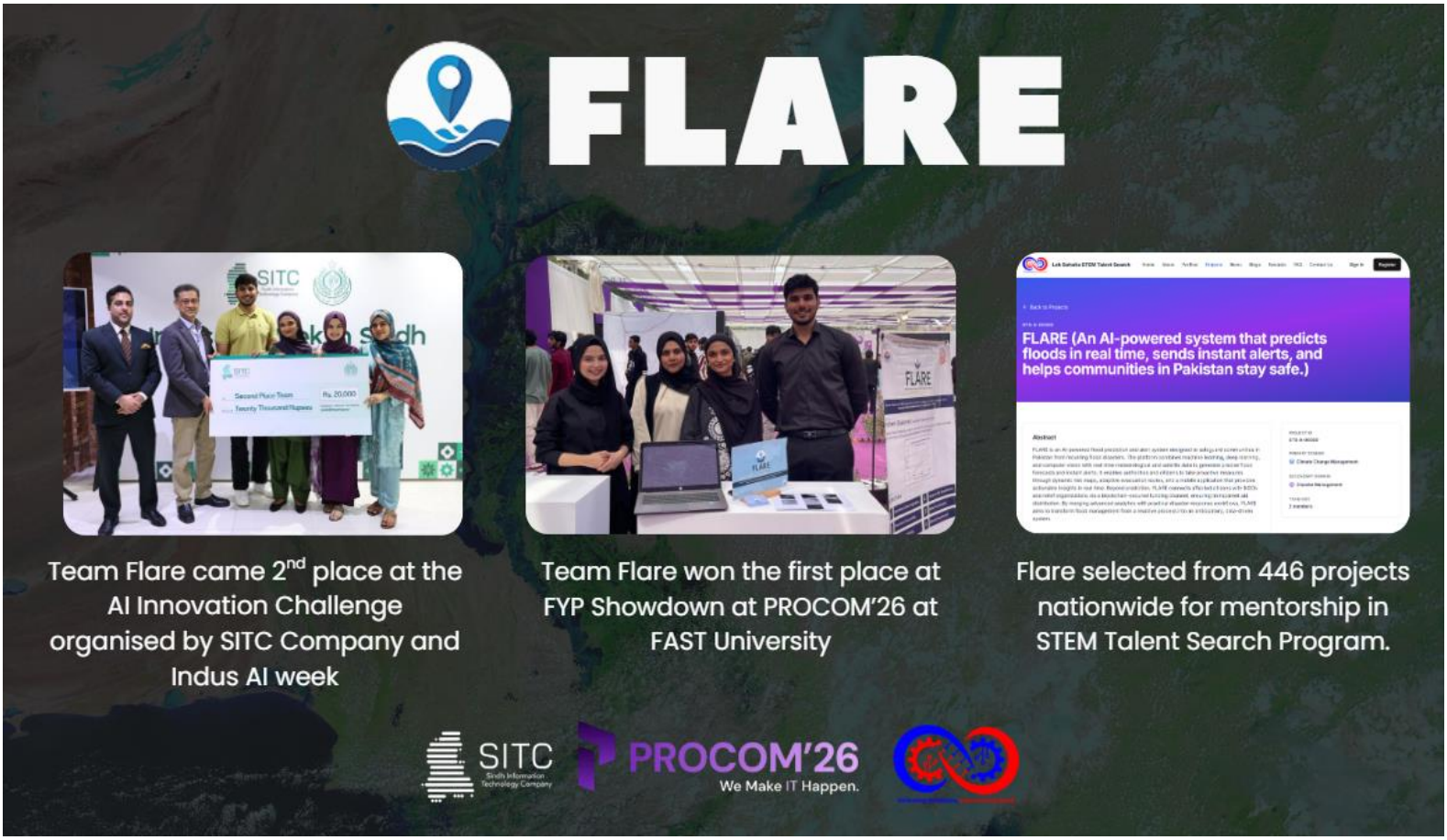
11	**Video (If any)**	Please provide the link of the video Demo Video

Pictures (to be pasted below)