**Title Page**  
**Project Title:** FACTORYSAFE-X: One Device. Dual Purpose. Total Protection.  
**Team Name:** Millennials  
**College Name:** Anurag University  
**IUCEE Student Chapter:** Anurag University IUCEE Student Chapter  
**Submission Date:** July 1, 2025

**Executive Summary**  
FACTORYSAFE-X is a dual-purpose IoT-powered safety system aimed at bridging the gap in early disaster warnings in both MSME factories and urban slums. It uses low-cost sensors, GSM alerts, and is solar-powered. With this innovation, we aim to save lives, minimize infrastructure loss, and promote resilient, disaster-ready communities.

**1. Chosen SDG Targets**

* **SDG 9:** Upgrade infrastructure and retrofit industries to make them sustainable and resilient.
* **SDG 11:** Reduce the adverse environmental impact of cities by strengthening disaster preparedness.
* **SDG 13:** Take urgent action to combat climate change and its impacts.

**2. Problem Statement**  
Industries and urban slums are highly vulnerable to environmental and industrial disasters including gas leaks, fires, floods, heatwaves, and seismic events. In factories (especially MSMEs), lack of affordable early warning systems leads to significant worker injury and machinery loss. In urban slums, people lack access to real-time alerts for flash floods, heatwaves, or tremors, risking lives and homes. Existing disaster preparedness technologies are expensive, location-specific, or not suited for the needs of low-resource users. There is a strong need for a unified, cost-effective, real-time early alert system for both industrial and community environments.

**3. Abstract**  
**Industrial Gaps:** Small-scale industries often operate without gas detection, heat monitoring, or fire alerts. Unmonitored vibrations from machinery cause accidents.  
**Urban Gaps:** Communities in flood-prone or seismically active zones have no local alert systems.  
**Solution Need:** The overlapping challenges of cost, reliability, and adaptability make a dual-purpose solution necessary. Stakeholders include factory managers, municipal bodies, community workers, and disaster relief groups.

**4. Existing Solutions & Limitations**

* **Fixed Industrial Alarm Systems:** Used in large factories; cost ₹50,000+. Not affordable for MSMEs.
* **Govt. Early Warning Systems (NDMA/IMD):** Satellite-based, city-level alerts. Not real-time or hyperlocal.
* **Smart Home IoT Sensors (e.g., Xiaomi, Nest):** Designed for homes. Not rugged or waterproof/fireproof.

**📊 Key Stats**

* 80% of MSMEs lack real-time safety alerts
* 70% of slum dwellers miss disaster warnings
* Industrial disasters up by 18% in 5 years (ET report)

**5. Proposed Solution: FACTORYSAFE-X**

* A single, portable, rugged device for industrial and urban safety
* Detects gas, fire, heat, flood, and seismic activity in real time
* Sends alerts via buzzer, LED, and optional SMS
* Switch between Factory Mode and Urban Mode
* Runs on rechargeable battery + solar panel
* Built to be waterproof, fireproof, and affordable

**6. Detailed Explanation of the Solution**  
**Technical Details:**

* **Sensors:** Gas (CO/CH4), Flame, Water Level, Heat (DHT11), Vibration (Seismic)
* **Microcontroller:** ESP32/Arduino
* **Alerting:** Buzzer, LEDs, GSM-based SMS
* **Power:** Rechargeable battery, optional solar panel
* **Build:** Waterproof, fireproof, portable enclosure
* **Mode Control:** Manual switch / mobile app toggle

**Workflow:**

1. Data Collection via Sensors: MQ2, IR flame sensor, water level, DHT11, Piezo/Accelerometer for vibration.
2. Data Processing: Arduino/ESP32 edge processing; optional cloud platforms like ThingSpeak/Blynk.
3. Alert Output: Buzzer & LEDs for local alerts, GSM (SIM800L) for SMS, optional mobile app.

**Interdisciplinary Elements:**

* **Electronics:** Sensor circuit design
* **CS/AI:** Embedded logic or ML-based prediction
* **Environment:** Sustainable alerting for underserved zones

**Design Thinking Applied:**

* **Empathy:** Studied user behavior in MSMEs and slums
* **Define:** Safety gap + lack of affordable tech
* **Ideate:** Single dual-purpose system
* **Prototype:** Modular, IoT-based prototype
* **Test:** Simulated in both environments

**7. Proof of Concept**  
**Prototype Description:** A rugged sensor system powered by a microcontroller and connected to GSM/GPRS for SMS-based alerts.

**Technologies Used:**

* Arduino/ESP32, DHT11, MQ2, IR flame sensor, water sensor, vibration sensor
* GSM module, Li-ion battery, optional solar unit

**Initial Results:**

* Successfully detected gas and fire triggers in factory simulation
* Detected water level and temperature spikes in mock urban testing

**8. Expected Outcomes**  
**Short-Term Benefits:**

* Alerts to prevent worker injury or equipment damage
* Warning before flash floods or urban fires

**Long-Term Benefits:**

* Saves lives and infrastructure in vulnerable zones
* Reduces disaster response cost
* Encourages disaster-aware infrastructure

**Environmental, Social, and Economic Benefits:**

* Prevents pollution from disaster aftermath
* Builds resilient infrastructure (SDG 9)
* Enhances community safety (SDG 11)

**9. Resources Required**  
**Technologies & Materials:**

* Sensors: Gas, temperature, flame, water, vibration
* Microcontroller: ESP32 or Arduino
* Enclosure: Fire/water-resistant material
* Power: Rechargeable battery + solar

**Budget Estimate (per unit):** ₹18,000 – ₹22,000

**Mentorship Needed:**

* IoT design
* Sensor integration
* Cloud dashboard (optional)
* Mobile app development (optional)

**10. Team Details**

| **Name** | **Department** | **Year** | **Role in Project** |
| --- | --- | --- | --- |
| Sukruth | ECE | IV | Hardware & Sensor Lead |
| Chethana | CSE | III | App & Dashboard Developer |
| Vinitha | CSE | III | Embedded Logic Developer |
| Sricharan | AIML | IV | AI Integration & Testing |
| Akhil | AI | IV | Communication & Simulation |

**11. Faculty Mentor**  
**Name:** Dr. Narendhar Singh  
**Designation & Department:** Associate Professor, ECE  
**Email:** [narendarsinghece@anurag.edu.in](mailto:narendarsinghece@anurag.edu.in)

**12. Optional: Images & Proofs**  
Sketches, sensor setup images, or screenshots of live data dashboards to be inserted by the team.

**13. Future Scope**

* Predictive AI models to reduce false alarms
* City-level dashboard integration
* App for crowd-sourced disaster reporting
* API for municipal integration

**Closing Statement**  
"FACTORYSAFE-X doesn't just alert — it empowers vulnerable communities and industries to face disasters with resilience, one smart sensor at a time."