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Indoor Fire Localisation using WSN and Fire Map Generation for Industrial Environment

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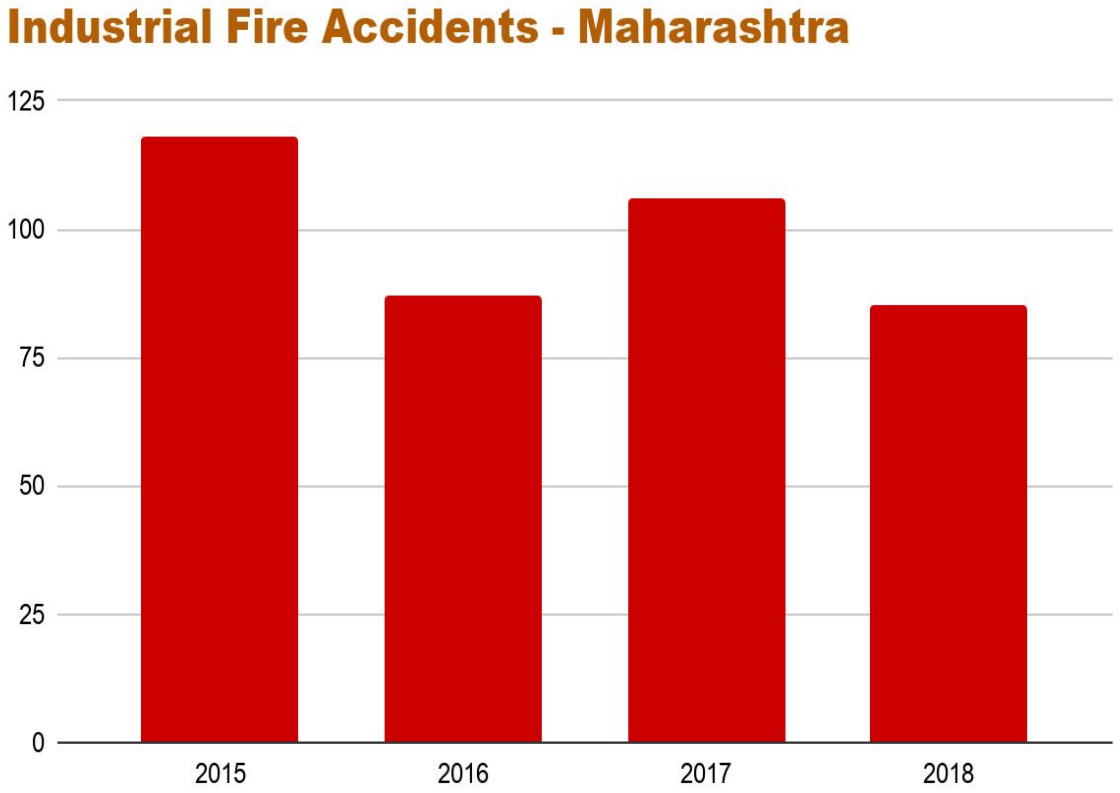
Introduction - Industrial Fire

- Industrial Fire kills more than 6,000 people in India every year.
- In Maharashtra alone there were ~350 major fire accidents in last four years.



SOURCE: MAHARASHTRA DIRECTORATE OF INDUSTRIAL SAFETY AND HEALTH

Related Work

Fire Detection -

1. *Lim, Yeon-sup, et al. "A fire detection and rescue support framework with wireless sensor networks." 2007 International Conference on Convergence Information Technology (ICCIT 2007). IEEE, 2007*

- Primary focus is on Fire detection and escape system using Wireless sensor Network for indoor environment

Fire Localization -

2. *Azmil, Muhammad Salihin Ahmad, et al. "Wireless fire detection monitoring system for fire and rescue application." 2015 IEEE 11th International Colloquium on Signal Processing & Its Applications (CSPA). IEEE, 2015.*

- Utilized smoke sensor along side vision sensor for fire detection and localisation in industrial environment.

Objective

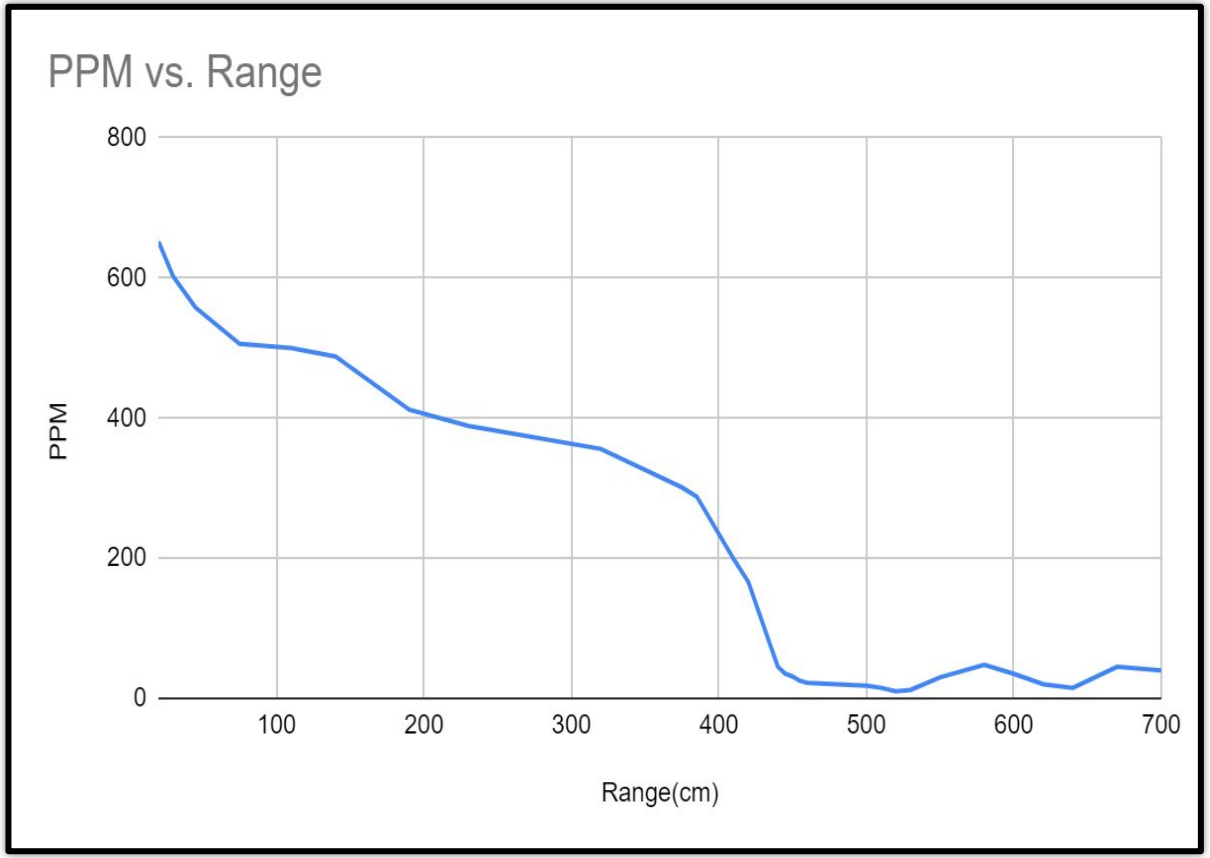
For Class A,B,C,D Fire types

Proposed System

Fig.- Overview of the system

Fire Detection

- Smoke Sensor: MQ - 2
- High Sensitivity and Low Directivity
- Effective Range: ~4 - 4.5 meters



Fire Localization

- IR Temperature Sensor: MLX90614ESF-A
- High Accuracy and Non Contact
- Effective Range: ~1.3 - 1.5 meters

Distance from the fire source (m)	Temperature Sensor (°C)	Thermometer (°C) At 10 cm from Fire Source	Error
0.1	72	73	-1
0.3	74	73	+1
0.5	72	74	-2
0.7	70	73	-3
1.0	71.5	74	-2.5
1.3	71	75	4
1.5	71.5	77	5.5
1.7	68.5	76	7.5

Unit Wireless Node Structure

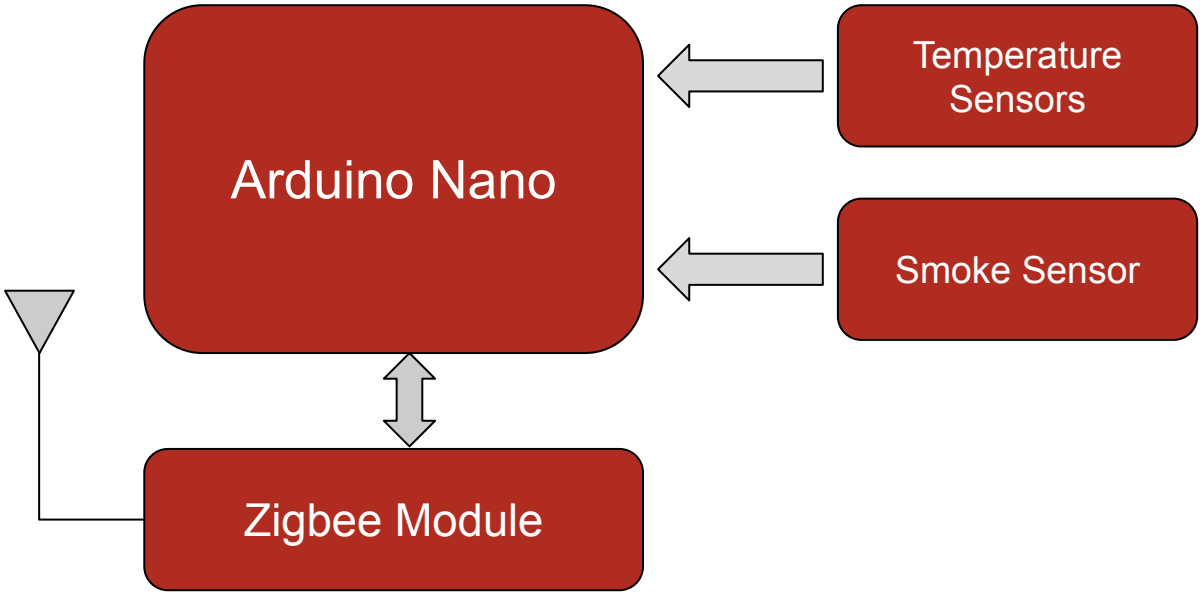
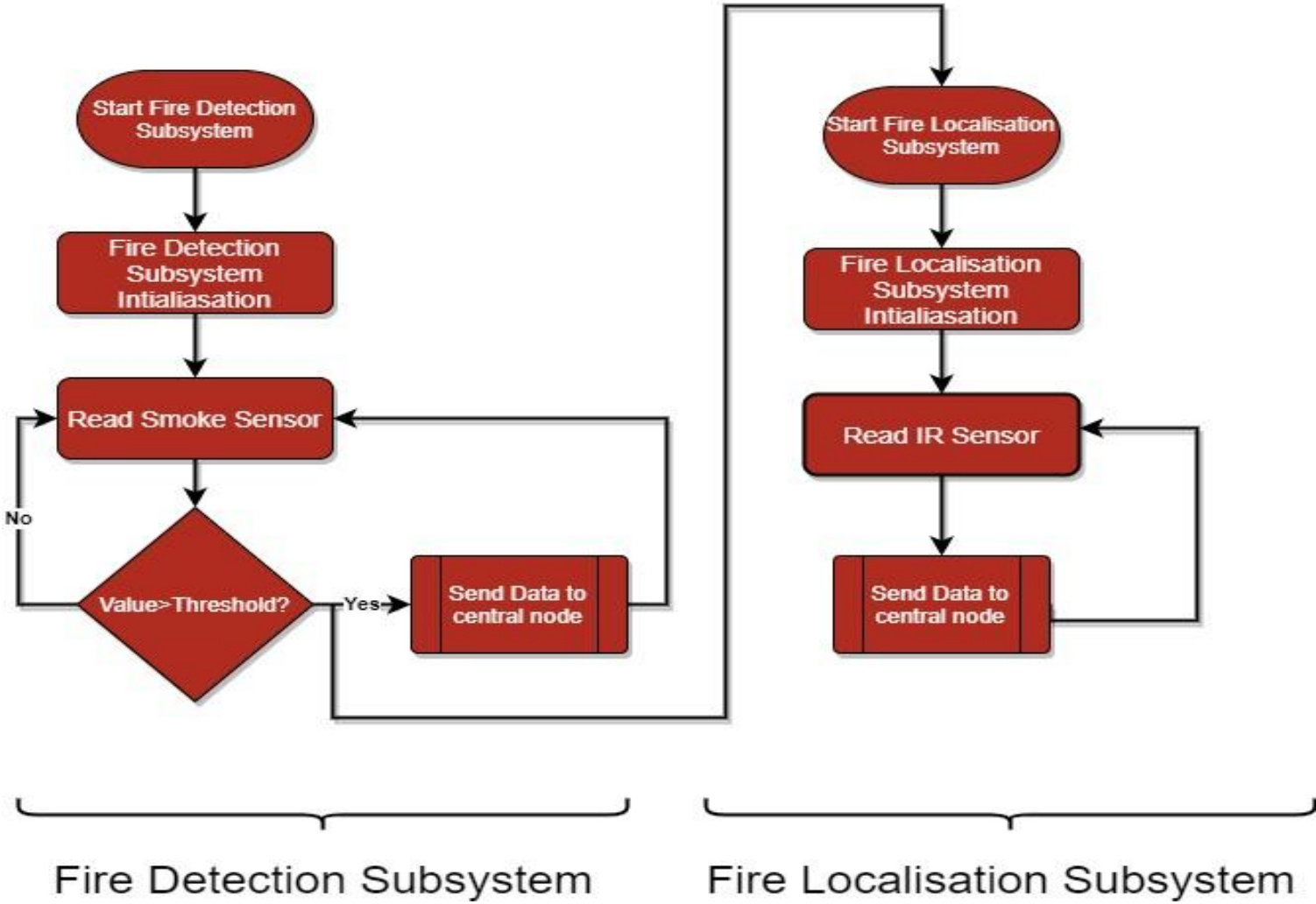


Fig.-Block diagram of wireless node

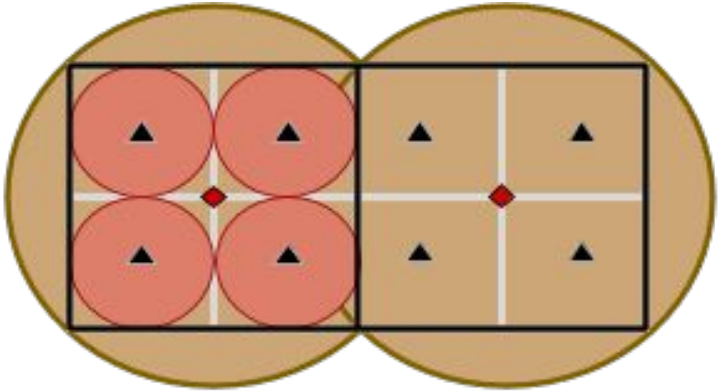
Fire Localisation and Detection Sub-System



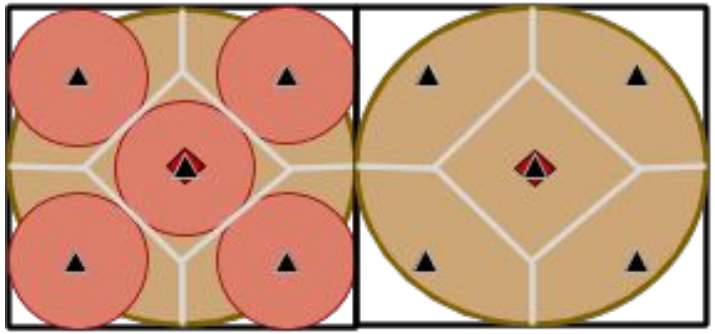
Pod Configurations

Design Characteristics -

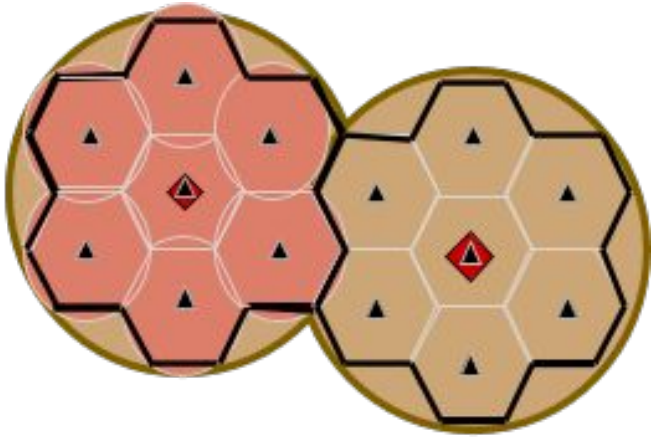
1. No. of Sensors per Pod
2. Scalability
3. Percentage of Detection Area
4. Percentage of Localisation Area



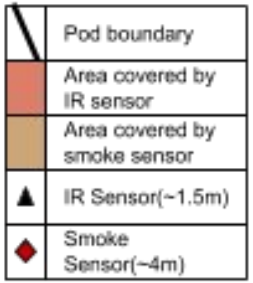
Configuration A



Configuration B

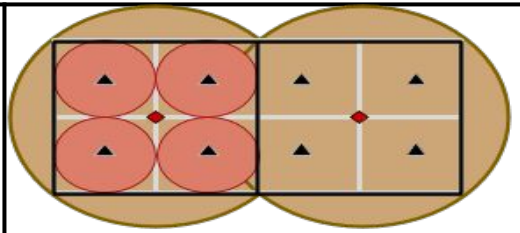
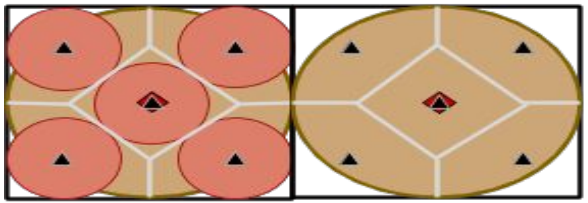
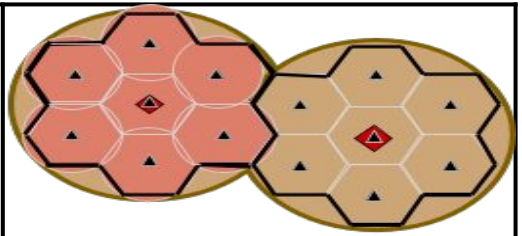


Configuration C

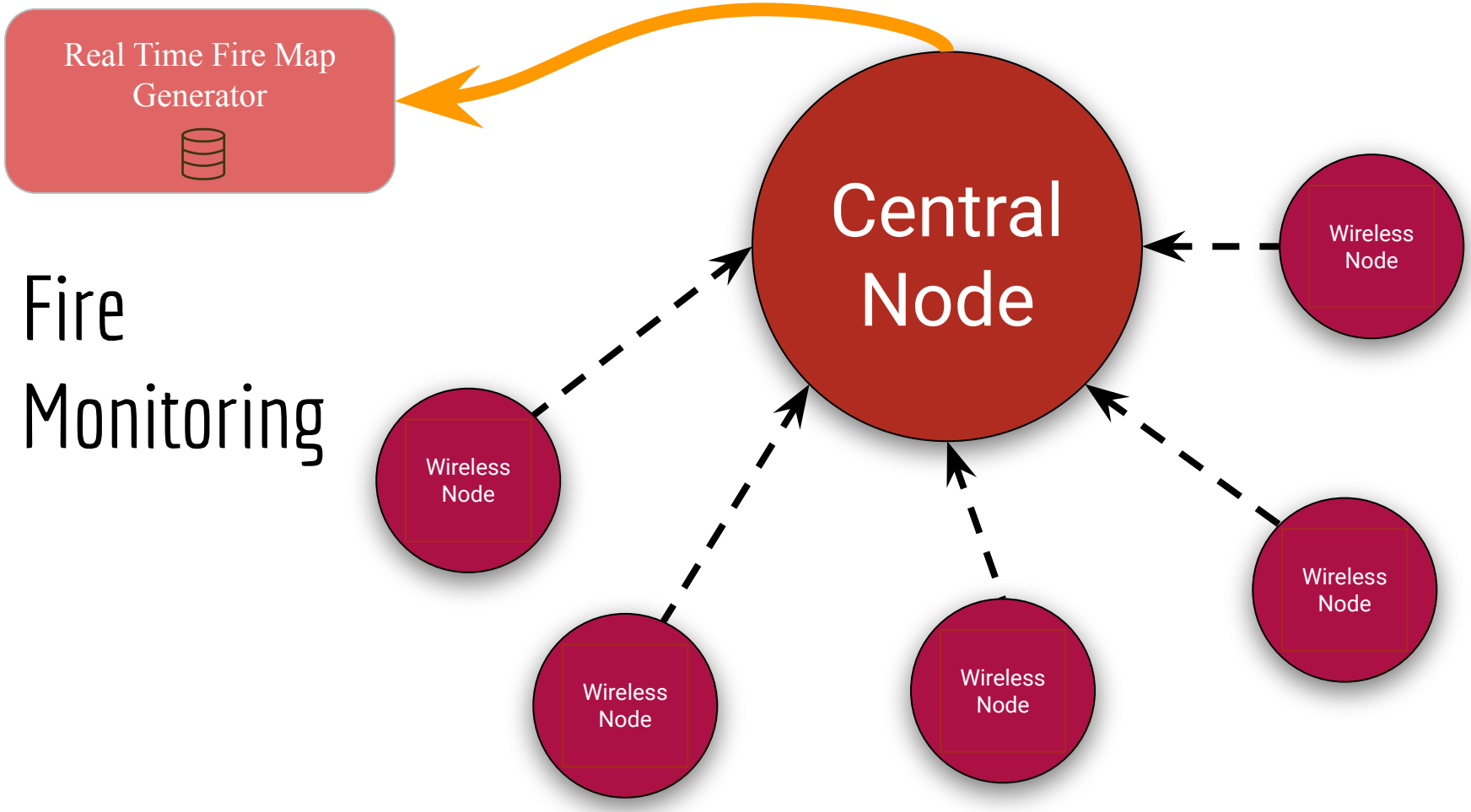


Result Analysis

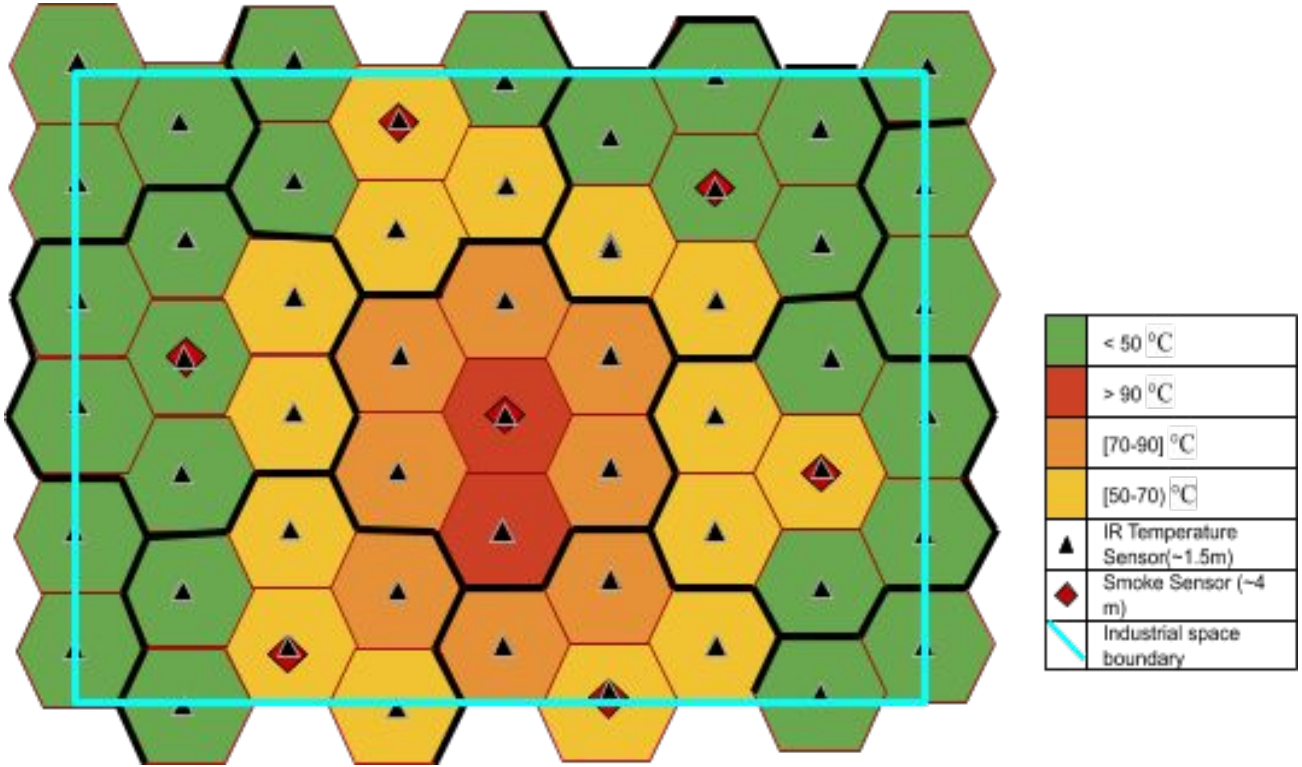
		Value
1	Floor Area	$400m^2$
2	Smoke Sensor Radius	4 m
3	Area Covered by Smoke Sensor	$50.26\ m^2$
4	IR Temperature Sensor Radius	1.5 m
5	Area Covered by IR Temperature Sensor	$7.06\ m^2$

Configuration	 Configuration A	 Configuration B	 Configuration C
Area of Cell(m^2)	8	16	5.8
No. of Cells in Pod	4	5	7
Area of Pod(m^2)	32	64	41
No. of IR Sensors	50	31	69
No. of Smoke Sensors	13	7	10
Total Sensor	63	38	79
Detection %	100	78.5	100
Localisation %	87.5	55.1	100
Use Case	Large Factories	Small to medium size enterprise factories	Critical facilities: Nuclear facilities, Ordnance factories

Fire Monitoring



Fire Map


< 50 °C
> 90 °C
[70-90] °C
[50-70) °C
IR Temperature Sensor(~1.5m)
Smoke Sensor (~4 m)
Industrial space boundary

Thank You