AirSniff

INTELLIGENT FIRE SURVEILLANCE AND AIR QUALITY SYSTEM

SMOKE HEAT PM2.5

This report is part of the Big Data Applications - Practical Applications
Graduate School of Applied Statistics

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1.Executive Summary

Pom Prap Sattru Phai District has the highest incidence of fire outbreaks in Bangkok. According to the Strategic and Evaluation Office, statistics from 2023 reveal that this district experiences an average of 12.43 fire incidents per square kilometer[1]. This ongoing problem significantly impacts the safety, health, and lives of residents in densely populated urban communities.

The AirSniff project was initiated to address this issue by deploying IoT technology and real-time data analytics using three types of intelligent sensors: smoke, heat, and PM2.5 sensors. A total of 325 sensors will be installed across the district. The system includes automated alerts via a centralized dashboard for relevant agencies, enabling a faster and more precise response to emergency situations.

The project is expected to reduce fire-related damages by over 50% within the first year, mitigate health risks caused by PM2.5 pollution, and establish a sustainable collaborative framework between local communities and government agencies. AirSniff aims to become a model for applying smart technologies to enhance urban safety.

2.Problem Statement

Urban fire hazards and PM2.5 air pollution have become critical, interlinked challenges in Bangkok, particularly in high-density, low-income communities. Throughout 2023, Bangkok experienced a severe increase in fire-related incidents and declining air quality, with data from the Department of Disaster Prevention and Mitigation reporting 4,417 fire cases citywide—of which 2,520 occurred in residential zones. These fires directly contributed to heightened levels of PM2.5, a pollutant that significantly compromises respiratory health and overall air quality in affected districts.

Pom Prap Sattru Phai District represents one of the most vulnerable areas, recording the highest fire density in Bangkok at an average of 12.43 incidents per square kilometer. This vulnerability stems from a combination of physical and systemic factors: densely packed housing constructed with combustible materials, unmanaged flammable waste, and electrical short circuits—all within an environment that lacks any form of early warning or monitoring infrastructure.

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1 https://webportal.bangkok.go.th/public/user_files_editor/299/3%20Pdf%2068/1%20%E0%B8%AA%E0%B8%96%E0%B8%B4%E0%B8%95%E0%B8%B4%E0%B8%9B%E0%B8%B5%202566.pdf

The consequences of these conditions are multifaceted. Fires spread rapidly through tight housing clusters, yet detection is frequently delayed due to the absence of centralized surveillance systems. Emergency response efforts are hindered by inadequate infrastructure and poor communication across agencies. Additionally, vulnerable communities often lack resources, training, and institutional coordination to manage or mitigate these risks. As a result, residents face increased injuries, loss of life, and property damage at rates disproportionate to other parts of the city. Compounding these impacts is the sustained exposure to PM2.5 particles from recurring fires, which worsens chronic respiratory conditions and places additional burdens on public health systems.

Without intervention, the cycle of fire outbreaks and air pollution in high-risk urban communities will continue to escalate—endangering lives, degrading the environment, and undermining urban resilience. Addressing this issue requires not only real-time detection technology but also community-based solutions that integrate fire monitoring, air quality tracking, and coordinated emergency response.

3.Market Opportunity and Competitive Analysis

3.1. Market Opportunity

3.1.1. Target Market Segmentation

3.1.1.1. Geographic Segmentation

The project focuses on serving urban areas with high population density and severe air pollution problems, such as Bangkok, Chiang Mai, and Khon Kaen. These cities are particularly vulnerable to fire incidents and elevated levels of air pollution, especially in informal settlements where safety infrastructure is insufficient. Rapid urban expansion and increasing population density in these areas have created a growing demand for efficient and accessible fire detection and air quality monitoring systems.

3.1.1.2. Demographic Segmentation

The primary target group includes residents of urban communities with low to middle income, who often live in areas highly vulnerable to fire incidents and air pollution. The target market also includes government agencies such as municipalities and the Department of Disaster Prevention and Mitigation, which are responsible for public safety. In addition, non-governmental organizations (NGOs) working in environmental protection and community health are key stakeholders, as they can utilize the data from this project to support their planning and implementation of various programs.

3.1.1.3. Behavioral Segmentation

This project is ideal for users who require real-time air quality data and fire alerts to support their daily decision-making and emergency response. These users include residents living in areas with a history of frequent fires or consistently high PM2.5 levels, as well as firefighters and community volunteers. Accurate and timely data delivery is a critical factor that enables the system to effectively meet the needs of these user groups.

3.1.1.4. Psychographic Segmentation

The project serves users who are highly conscious of environmental and health issues. These individuals tend to have a lifestyle that prioritizes clean air and are motivated to actively participate in preventing fires and reducing pollution. Additionally, community leaders and institutions that emphasize sustainable development and socially responsible investment (ESG) are important beneficiaries of the system.

3.1.2. Customer Analysis

3.1.2.1. Urban Residents in High-Risk Communities

This group consists of individuals living in informal settlements or densely populated urban areas, such as Pom Prap Sattru Phai District in Bangkok, where infrastructure for fire prevention and safety is inadequate. These communities are highly vulnerable to both fire hazards and air pollution. Installing the AirSniff system in such areas will enable residents to receive timely emergency alerts and make informed decisions, ultimately helping them to live more safely and proactively manage daily environmental risks.

3.1.2.2. Government Agencies and Local Authorities

Agencies such as municipal governments, the Department of Disaster Prevention and Mitigation, and environmental offices play a key role in safeguarding public health and safety. By adopting the AirSniff system, these agencies can monitor air quality and detect fire incidents in real time, which greatly enhances their ability to respond quickly and effectively to emergencies.

3.1.2.3. Firefighting Units

First responders responsible for fire suppression and rescue operations. Equipped with real-time data, location-specific alerts, and visual dashboards, they can improve their operational readiness, reduce response times, and allocate resources more effectively to high-risk areas.

3.1.2.4. Non-Governmental Organizations (NGOs)

Organizations focused on environmental issues and community health, as well as academic researchers, can benefit from the data collected by the AirSniff system. This data can be used to analyze patterns, identify risk zones, and develop targeted interventions to improve the quality of life for residents in high-risk areas. Furthermore, it provides a valuable resource for research aimed at developing more effective strategies for managing urban air pollution and fire safety.

3.1.2.5. ESG-Oriented Investors and Project Sponsors

As environmental, social, and governance (ESG) investing gains momentum, many investors and project sponsors are actively seeking initiatives that generate positive social and environmental impact. The AirSniff system, which contributes to fire risk reduction and improved air quality in urban communities, aligns strongly with ESG investment principles. This makes it an attractive candidate for funding and support from both the public and private sectors.

3.1.3. Market Size and Potential

3.1.3.1. Fire Alarm System Market Size

The global fire alarm system market is expected to experience steady growth. In 2024, the market was valued at approximately USD 35.86 billion and is projected to reach USD 58.79 billion by 2031, with a compound annual growth rate (CAGR) of 7.4% between 2025 and 2031[2]. This growth is driven by the increasing number of fire incidents in urban areas and the enforcement of stricter safety regulations. For AirSniff, which focuses on serving high-risk urban communities, this growing market represents an opportunity to expand and offer technologies that effectively meet evolving safety demands.

3.1.3.2. Southeast Asia Air Quality Monitoring Market Size

The air quality monitoring system market in Southeast Asia is expected to grow significantly, with a market value projected at USD 276.51 million in 2025 and anticipated to reach USD 435.29 million by 2030, reflecting a CAGR of 9.5%[3]. The growth is fueled by worsening air pollution in major cities such as Bangkok and increased governmental focus on improving public health and air quality. AirSniff's ability to deliver real-time air quality data and precise alerts positions it well to address the rising demand in this regional market.

[2]https://www.globenewswire.com/news-release/2025/04/04/3055851/0/en/Fire-Alarm-System-Market-Size-Worth-58-79-Billion-by-2031-at-7-4-CAGR-Globally-Exclusive-Report-by-The-Insight-Partners.html
[3] https://www.mordorintelligence.com/industry-reports/southeast-asia-air-quality-monitoring-market

3.1.3.3. Global Air Quality Monitoring System Market Growth

Globally, the air quality monitoring system market is projected to grow from USD 5.80 billion in 2024 to USD 8.89 billion by 2030, with a CAGR of 7.5% from 2025 to 2030[4]. This growth is driven by technological advancements, including the integration of IoT and high-precision environmental sensors. As AirSniff incorporates these technologies into its system, it is well-positioned to meet the increasing global demand for real-time and reliable air quality monitoring solutions.

3.1.3.4. Smart City and ESG Investment Opportunities

The expansion of smart city initiatives in Thailand—such as Smart Bangkok, Phuket Smart City, and Chiang Mai Smart City—has created new opportunities for technologies that enhance urban living. Projects like AirSniff, which provide real-time fire alerts and air quality insights, have strong potential to become integrated into the infrastructure of these smart cities. Moreover, the rise of environmental, social, and governance (ESG) investment trends has opened up further support opportunities for impactful projects. With its social and environmental relevance, AirSniff aligns well with ESG priorities and stands to attract interest from both public and private sector investors.

3.1.4. Market Trends

3.1.4.1. Urbanization & Densification

In Bangkok, approximately 579,630 people, or around 29% of the city's population, live in informal settlements. These communities often face social vulnerability, limited access to public services, and unsafe living conditions. Rapid urban expansion has outpaced the development of safety infrastructure, leaving many areas without early warning systems or rapid response capabilities. As a result, there is a pressing need for smart community-level alert systems to enhance safety and resilience.

3.1.4.2. Smart Cities Movement

Smart city development initiatives in Thailand, such as Smart Bangkok, Phuket Smart City, and Chiang Mai Smart City, are driving the adoption of IoT, big data, and sensor-based technologies to enable real-time environmental monitoring and management[5]. AirSniff aligns closely with this vision, offering a solution designed for high-risk areas that provides accessible, practical, and scalable early warning systems to protect urban communities.

[4] https://www.grandviewresearch.com/industry-analysis/air-quality-monitoring-system-market
[5] https://www.frontiersin.org/journals/sustainable-cities/articles/10.3389/frsc.2024.1473123/full

3.1.4.3. Air Quality Awareness

PM2.5 pollution has been classified as a “public health emergency” by the World Health Organization (WHO) and has gained increasing attention, particularly during haze seasons. In 2023, approximately 10 million people in Thailand sought medical treatment for health issues linked to air pollution[6]. Consequently, the demand for real-time, hyperlocal air quality data has surged, as individuals need timely information to make informed decisions for their health and daily activities. AirSniff effectively addresses this need by delivering real-time air quality monitoring at the community level.

3.1.4.4. Tech-Driven Safety with IoT & AI

The declining cost of IoT sensors has made it more feasible to deploy widespread risk detection systems, particularly for public-sector projects. Furthermore, the integration of AI technologies enables real-time data analysis from sensors, allowing the detection of anomalies such as abnormal temperature spikes or sudden increases in PM2.5 levels[7]. These advancements allow AirSniff to offer predictive alerting capabilities, moving beyond reactive systems to proactively detect and mitigate risks.

3.1.4.5. ESG & Impact Investing Trends

Investors and government agencies are increasingly prioritizing projects that deliver positive social and environmental impacts, aligning with Environmental, Social, and Governance (ESG) principles. Thailand has launched new ESG funds, such as the "Thai ESG Extra" fund, to promote sustainable investment while offering tax incentives to investors[8]. Projects like AirSniff, which reduce disaster risk and improve public health in urban communities, are likely to attract growing support from ESG-focused investment initiatives.

3.1.4.6. Data-as-a-Service (DaaS) Opportunities

The AirSniff system generates high-value data, including fire incident statistics, hyperlocal PM2.5 readings, and risk trend analytics. This information can be packaged into customized historical reports or analytical insights to support urban planning, insurance risk assessment, and public health research. These data services present additional revenue opportunities beyond the initial system deployment, while reinforcing the project's role in enabling evidence-based decision-making.

[6] https://cities-today.com/bangkok-joins-breathe-cities-initiative-to-cut-air-pollution/
[7] https://www.sciencedirect.com/science/article/pii/S209044792500022X
[8] https://www.nationthailand.com/business/economy/40047286

3.1.5. Market Gaps and Opportunities

3.1.5.1. Gaps in Community-Level Air Quality Monitoring Systems

Although major cities in Southeast Asia have established air quality monitoring stations, many informal settlements and rural areas still lack comprehensive and accessible monitoring systems. The deployment of low-cost sensors that can be installed directly within communities represents a critical opportunity to fill this gap, particularly in high-risk areas where air pollution levels are consistently elevated.

3.1.5.2. Lack of Data for Policy Planning

Many countries in Southeast Asia still suffer from insufficient data for effective air quality management and fire prevention policy planning. Establishing systems that provide real-time, wide-coverage environmental data would significantly enhance the ability of relevant agencies to make informed decisions and implement more effective strategic plans.

3.1.5.3. Opportunities to Develop Locally Appropriate Technologies

There is a significant opportunity to develop technologies that are tailored to the specific contexts of Southeast Asian communities. These include using solar-powered solutions, mobile network connectivity, and designs that are resilient to harsh weather conditions. Creating adaptable and affordable air quality and fire detection systems will be a key factor in achieving broader acceptance and adoption across diverse communities[9].

3.1.5.4. Support from Smart City Initiatives and ESG Investment Trends

Smart city initiatives in the region are increasingly seeking technologies that can improve the quality of urban life. Systems like AirSniff, which provide real-time data and early warnings for fires and air quality issues, have strong potential to be integrated into the infrastructure of these smart cities. Furthermore, the growing trend toward environmental, social, and governance (ESG) investment creates additional opportunities for projects that deliver positive social and environmental impacts to attract funding and support from investors and public sector stakeholders.

[9] https://www.undp.org/policy-centre/singapore/blog/applications-low-cost-air-quality-sensors-citizen-engagement-and-air-pollution-mitigation

3.2. Competitive Analysis

AirSniff's competitors can be divided into two main groups: Domestic Competitors and Global Competitors.

3.2.1. Domestic Competitors

3.2.1.1. NECTEC[10]

NECTEC (National Electronics and Computer Technology Center) plays an important role in developing sensor and IoT technologies within Thailand, particularly through research and development of air quality monitoring systems. One such initiative is the "Air Quality Sensing Platform," which emphasizes the use of low-cost sensors that can connect via cloud systems. These solutions are well-suited for localized applications such as schools, communities, or small government agencies. However, most of NECTEC's projects remain at the prototype or research phase rather than being widely commercialized in the market[11].

3.2.1.2. SCG Smart Living[12]

SCG Smart Living focuses on the development of products and services aimed at improving indoor health environments, such as the SCG Active AIR Quality system, which filters PM2.5 and enhances indoor air circulation through smart ventilation technology. These solutions are primarily targeted at residential homes and real estate developments. SCG holds advantages in brand strength, premium design, and integration with other construction products. However, their systems are not designed for use in informal urban settlements or in addressing the specialized risks faced by high-risk communities, unlike AirSniff.

3.2.2. Global Competitors

3.2.2.1. Honeywell[13]

Honeywell is a global leader in fire detection and air quality monitoring systems, offering highly accurate sensors for PM2.5, CO2, VOCs, and integrated Building Management Systems (BMS). Their solutions are ideal for hospitals, schools, and commercial buildings, seamlessly integrating with automation platforms. However, due to the high cost and complexity of their systems, Honeywell’s products are less suitable for deployment in communities with budget constraints or in smaller, more localized environments.

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[10] https://www.nectec.or.th/wp-content/uploads/2023/10/NECTEC-Annual-report2022-en.pdf
[11] https://nectec.or.th/ace2024/wp-content/uploads/2024/09/ss4-4-Suramate.pdf
[12] https://solarquarter.com/2024/11/07/onnex-by-scg-smart-living-unveils-new-solar-zones-and-indoor-air-quality-solutions-at-scg-home-experience-featuring-exclusive-year-end-promotions
[13] https://hbtmkto.honeywell.com/IAQ-Sensors.html

3.2.2.2. Siemens[14]

Siemens is a world-leading manufacturer of building control systems and air quality monitoring devices, focusing on smart buildings, Smart City initiatives, and large-scale industrial sectors. Siemens' sensors can measure a variety of air quality indicators, including PM2.5, CO2, VOCs, and temperature, and are well-integrated with HVAC control and SCADA systems. However, Siemens targets large-scale projects with substantial budgets, which may not align well with grassroots urban communities or low-cost, flexible solutions such as AirSniff.

3.2.3. Competitive Comparison Table

Comparison Criteria	AirSniff	NECTEC Air Quality Sensor	SCG Smart Living Solutions	Honeywell	Siemens
Target Area	High-risk urban communities (fire/air pollution)	Urban areas and research pilot zones	Residential housing and Smart City projects	Industrial and commercial buildings	Industrial infrastructure and large-scale structures
Sensor Technology	Smoke, Heat, PM2.5 Sensors	PM2.5, CO2, Temperature Sensors	Temperature, Smoke, PM2.5 Sensors	Advanced fire and gas detection sensors	Building automation and fire alarm systems
Installation Cost per Unit	Low (THB 5,000–8,000 per unit)	Medium (around THB 10,000 per unit)	High (around THB 15,000 per unit)	High (more than THB 30,000 per unit)	High (more than THB 40,000 per unit)
Designed for Dense Urban Communities	Specifically designed for informal settlements	Tested in general urban areas	Focused on real estate projects	Focused on industrial sector	Focused on large-scale infrastructure
Automated Alert Capability	Dashboard-based	Graph-based web monitoring only	IoT platform dashboard available	Alerts via SCADA or	Integrated with BMS, SCADA systems

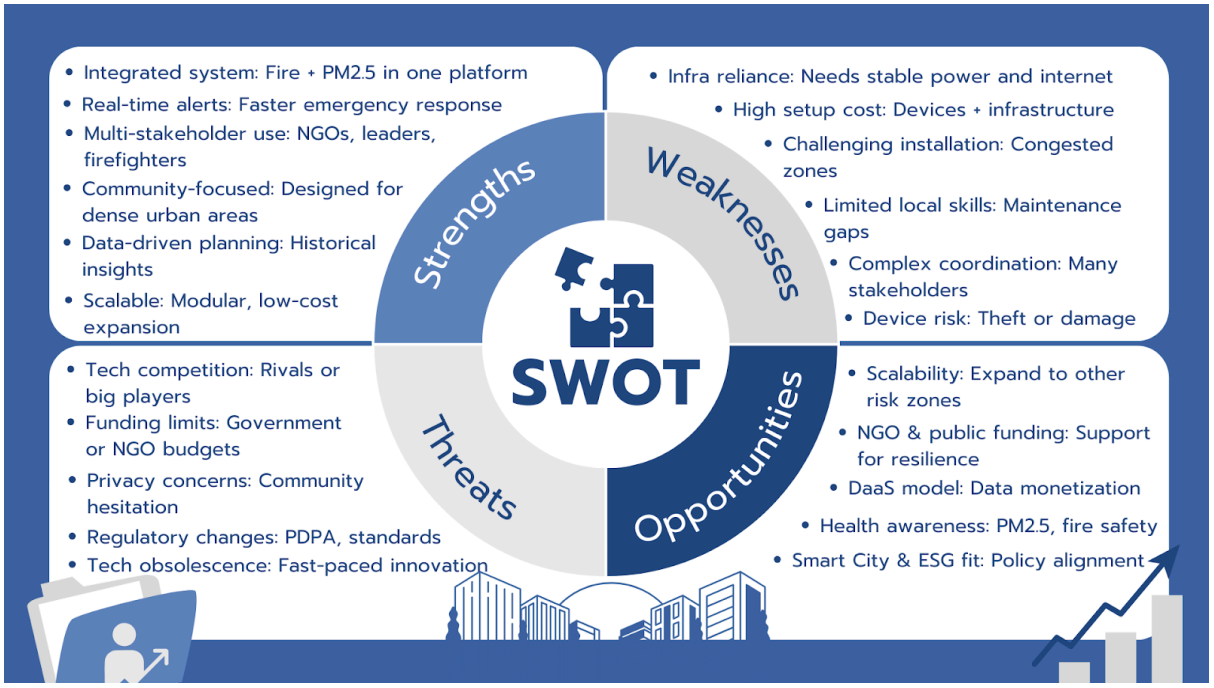
[14] https://www.siemens.com/us/en/products/buildingtechnologies/hvac/sensors/air-quality-sensors.html

Comparison Criteria	AirSniff	NECTEC Air Quality Sensor	SCG Smart Living Solutions	Honeywell	Siemens
	real-time alerts, SMS			automation systems	
Scalability and Low-Cost Expansion	Easily scalable at low cost	Difficult to scale due to high cost	Project-based sales model	Designed for large industrial scale	Requires extensive infrastructure
Key Strengths	Specially designed for high-risk communities	Developed domestically by research institutes (NECTEC)	Full-suite smart home services	High accuracy and global standard technologies	Comprehensive smart building infrastructure solutions
Key Weaknesses	Still in pilot phase; needs expansion support	Not yet commercialized widely	Too costly for low-income communities	Expensive; not suitable for low-income urban areas	Inflexible; unsuitable for small or budget-constrained areas

Based on the competitive analysis of both domestic and global players, it is evident that AirSniff stands out distinctly in the high-risk urban community market, particularly in densely populated areas that often lack infrastructure for emergency alert systems. AirSniff has been specifically designed to be low-cost, easy to use, and capable of providing real-time alerts through a dashboard, offering a solution that perfectly fits the practical needs of urban communities with limited budgets and technological resources.

While major global competitors such as Honeywell and Siemens focus on high-precision systems designed for large-scale buildings and industrial sectors — resulting in high costs and limited suitability for typical urban communities — domestic competitors like NECTEC and SCG, despite their technical capabilities, have yet to fully address the needs of vulnerable community markets. Therefore, AirSniff's strength lies in its localization approach and flexibility in deployment and scalability, positioning it as a true leader within this specialized market segment.

3.3. SWOT Analysis



3.3.1. Strengths

- **Integrated Monitoring Solution**: Combines fire detection (heat and smoke sensors) with environmental monitoring (PM2.5) in a single unified platform
- **Real-time Alert System**: Provides immediate notifications to multiple stakeholders (NGOs, community leaders, firefighters) reducing response times
- **Community-Focused Design**: Specifically developed for high-density urban areas where traditional systems are inadequate
- **Multi-stakeholder Engagement**: Creates a coordinated network between NGOs, local leaders, and emergency services
- **Data-Driven Approach**: Collects comprehensive data for both immediate alerts and long-term risk analysis
- **Scalable Architecture**: System can start small and expand throughout a community as resources become available
- **Dual-Purpose Value**: Addresses both emergency response (fires) and ongoing health concerns (air quality)

3.3.2. Weaknesses

- **Initial Capital Investment**: Requires significant upfront funding for sensor deployment and network infrastructure
- **Implementation Complexity**: Installation in existing dense settlements presents logistical challenges

- **Dependence on Infrastructure**: Requires reliable electricity and internet connectivity which may be inconsistent in target areas
- **Technical Maintenance Requirements**: Local capacity for sensor maintenance and calibration may be limited
- **Multiple Stakeholder Coordination**: Success depends on effective collaboration between diverse groups with different priorities
- **Sensor Vulnerability**: Physical sensors may be subject to damage, theft, or vandalism in some environments

3.3.3. Opportunities

- **Growing NGO Focus on Urban Resilience**: Increasing international funding for disaster prevention in vulnerable communities
- **Rising Awareness of Air Quality Issues**: Growing concern about PM2.5 and its health impacts creates additional value proposition
- **Smart City Initiatives**: Government investments in urban technology infrastructure that could support system deployment
- **Regulatory Support**: Potential for favorable policies requiring improved fire safety measures in high-risk areas
- **Data Monetization Potential**: Anonymized environmental and infrastructure data could provide valuable insights for urban planning

3.3.4. Threats

- **Competing Technologies**: Emergence of alternative fire detection systems with similar capabilities
- **Budget Constraints**: Limited NGO funding and competing priorities for community development resources
- **Regulatory Hurdles**: Potential regulatory barriers to sensor deployment and data collection
- **Community Resistance**: Possible concerns about privacy or technological intrusion in traditional communities
- **Technology Leapfrogging**: Risk of current sensor technology becoming obsolete as newer solutions emerge

4.Strategic Vision and Execution Plan

4.1. Vision

To become a leading provider of intelligent air quality and fire surveillance systems that protect lives and property, and sustainably enhance the safety of urban communities.

4.2. Mission

Promote the use of intelligent technology to generate accurate and reliable data through a surveillance system that enables local authorities and non-governmental organizations to access real-time fire alert systems and strengthen collaborative disaster preparedness in high-risk urban areas.

4.3. Scope

- Install smoke, heat, and PM2.5 sensors in densely populated communities to enable timely alerts for fire incidents and air pollution.
- Develop dashboards for NGOs, local communities, and government firefighting agencies to support efficient data analysis and emergency response planning.
- Generate periodic fire detection reports to support future risk assessment and preparedness planning.
- Integrate dashboards and data processing systems with the infrastructure of relevant agencies to ensure real-world operational readiness at the local level.

4.4. Objectives

- Develop a fire detection system with an accuracy rate of no less than 95%, based on data analysis from heat, smoke, and PM2.5 sensors.
- Build an automatic alert system that can send notifications via dashboard and SMS to relevant agencies and stakeholders within 3 minutes after detection.
- Design a real-time monitoring system for device operational status to detect malfunctions and issue alerts when devices are not functioning properly.
- Implement a system that sends daily operational status updates to the central platform to ensure continuous system functionality.

4.5. Business Strategy

4.5.1. Market Entry through a B2G2C Model

AirSniff will adopt a B2G2C (Business-to-Government-to-Community) strategy to scale the deployment of its intelligent surveillance system in high-risk urban communities. The primary source of revenue will come from government procurement—such as from municipalities and disaster prevention agencies—while the direct beneficiaries will be vulnerable populations. Collaborating with government entities as both financial backers and technology adopters will ensure that the project can scale effectively and be sustainably integrated over the long term.

4.5.2. Innovating for Dense Urban Environments

AirSniff's strength lies in its low-cost, modular system design, which is optimized for densely populated urban areas such as informal settlements in Pom Prap Sattru Phai. The system is easy to install, provides real-time alerts, and is simple to operate—even in areas that lack technological infrastructure. This makes it distinct from major competitors who primarily serve industrial or high-end smart building markets.

4.5.3. Aligning with Smart City Strategies and ESG Trends

AirSniff will align its expansion roadmap with Thailand's national Smart City initiatives, such as Smart Bangkok and Smart Chiang Mai. Simultaneously, the project will position itself as an ESG-enabling technology—advancing environmental sustainability (Environment), public health equity (Social), and data transparency (Governance). This alignment will open opportunities for accessing funding and building cross-sector partnerships.

4.5.4. Expanding into Data-as-a-Service (DaaS) for Long-Term Revenue

Beyond its core function as an alert system, AirSniff can evolve into a valuable data platform—providing insights such as PM2.5 levels, fire incident statistics, and risk trend analytics. This data can be packaged and sold as Data-as-a-Service (DaaS) to research institutions, NGOs, urban planners, and insurance companies, creating a recurring long-term revenue stream.

4.5.5. Driving Sustainability Through Community Co-Ownership

A key success factor is building a co-ownership model with local communities. Stakeholders will be granted access to dashboards, receive training, and take part in device maintenance. This participatory approach builds trust, fosters collaboration, and improves data accuracy and responsiveness—ensuring long-term sustainability of the system.

4.5.6. Phased Expansion Based on Risk Zoning

The rollout will begin in Pom Prap Sattru Phai and follow a phased, zone-based expansion model, targeting urban districts with similar risk profiles—such as those in Bangkok, Khon Kaen, and Chiang Mai. Each phase will be used to validate outcomes, enhance operational efficiency, and serve as a foundation for attracting additional funding from both public and private sectors.

5.Project Deliverables

Project Start Date: January 1, 2026
Estimated Completion Date: November 30, 2026

5.1. Key Deliverables

Deliverable	Due Date	Responsible Party
Installation of 325 sensors in the community	31 March 2026	Field Operations Team
Development of dashboard and alert system	31 August 2026	Software and Data Engineering Team
System testing and data verification	30 September 2026	Data Governance Team
Final report, performance evaluation, and troubleshooting	30 November 2026	Analytics Team and Community Partners

5.2. Project Timeline & Key Milestones

Milestone	Target Date	Owner
Project Kickoff	January 1, 2026	Project Manager
Complete Installation of 325 Sensors	March 31, 2026	Field Team
Develop Alert Dashboard	August 31, 2026	Technical Team
System Testing and Midterm Report	September 30, 2026	Data Team & Stakeholders (Joint Review)
Final Project Evaluation	November 30, 2026	Project Coordinator

6.Business Model

6.1. Primary Business Model: B2G2C (Business to Government to Community)

1. **Key Clients:** Government agencies, including municipal offices, the Bangkok Metropolitan Administration (BMA), and the Department of Disaster Prevention and Mitigation, as well as non-governmental organizations (NGOs)
2. **Target Beneficiaries:** Communities residing in high-risk areas and the general public

6.2. Target Customer Segments

1. **Government Sector:** Agencies responsible for disaster prevention and mitigation, city/metropolitan municipalities, and air quality management authorities
2. **Non-Governmental Organizations:** Organizations focused on environmental protection and community safety
3. **Urban Communities:** Residents in high-risk urban zones
4. **Impact-focused Stakeholders:** Investors and sponsors of ESG (Environmental, Social, and Governance) initiatives

6.3. Value Proposition

1. **Fire Loss Reduction:** Estimated reduction of fire-related damages by approximately 50% within the first year
2. **Real-time Alerting:** Emergency alerts issued within 3 minutes, contributing to shorter response times
3. **Health Risk Mitigation:** Early warning systems for hazardous PM2.5 levels help reduce exposure and associated health risks
4. **Data-Driven Planning:** Accumulated historical data enables authorities to analyze risk-prone areas and formulate effective preventive measures

6.4. Revenue Streams

AirSniff adopts a **B2G2C model**, delivering its technology to government agencies or non-profit organizations that, in turn, use the system to support high-risk communities. This approach not only aligns with public interest but also creates a sustainable pathway for wide-scale impact through public-sector funding.

The primary source of revenue is based on a **one-time purchase**, which includes two key components. First, the **System Deployment Fee** is a flat-rate charge paid by government clients, covering the complete setup of the AirSniff solution. This includes the procurement and installation of IoT sensors, network infrastructure, dashboard development, and hands-on training for local staff. Once the system is installed and deployed, it becomes fully operational and ready for immediate use. Typically, this cost is covered by municipal governments or disaster prevention agencies under initiatives such as urban safety or smart city programs.

Second, **Data Services** are offered as part of the initial package at no additional recurring cost. These services provide valuable analytical insights, including fire incident trends, PM2.5 exposure patterns, and AI-driven risk forecasts. The data is tailored for use in government planning, research initiatives, and public safety strategies, making it a powerful decision-support tool. Clients such as urban planners, environmental researchers, and insurance firms can leverage this intelligence to enhance preparedness and policy design.

6.5. Key Partners

1. **Technology & Infrastructure Providers**
    - IoT Sensor Manufacturers: Supply heat, smoke, and PM2.5 sensors for field deployment
    - Cloud Platform Providers: Host real-time data ingestion, storage, and analytics
    - Software Developers / System Integrators: Build the dashboard, alert system, and data analytics tools
2. **Government & Public Sector Agencies**
    - Municipal Governments: Fund and adopt the system for city-level deployment
    - Disaster Prevention & Environmental Departments: Use the data for emergency response and urban air quality planning
3. **NGOs & Research Institutions**
    - Environmental NGOs & Community Organizations: Implement the system in vulnerable areas and promote community resilience
    - Universities & Research Labs: Collaborate on data analysis, predictive modeling, and public health studies
4. **ESG Investors & Impact Funders**
    - Provide grants or co-investment aligned with environmental and social goals
    - Support scale-up through sustainability-linked financing and pilot funding
5. **Local Implementation Partners**
    - Community Leaders & Field Teams: Facilitate sensor deployment, local maintenance, and community engagement
    - Local SMEs or Social Enterprises: Handle on-ground operations, training, and device servicing

6.6. Expansion Opportunities

1. **Geographical Expansion:** Rollout from the Pom Prap Sattru Phai District to other high-risk areas within Bangkok and to major provinces nationwide
2. **Additional Sensor Types**: Detection of other toxins or other types of disasters
3. **White Label Solution**: Allowing other organizations to use the technology under their own brand
4. **Automated Prevention Systems**: Future connectivity with automatic fire suppression systems

6.7. Business Value Assessment

1. **High Return on Investment (ROI)**
    - Reduces fire-related damages and health risks, creating significant cost savings for government agencies
    - Demonstrates a positive ROI within 2–3 years through reduced emergency response costs and public health expenditure
2. **Tangible Community Impact**
    - Enhances safety and quality of life in high-risk urban areas
    - Empowers local communities with real-time alert systems and data access
3. **Supports Policy and Planning**
    - Enables data-driven urban planning, zoning, and resource allocation
    - Provides insight for long-term risk reduction and public safety strategies
4. **Alignment with ESG and Smart City Goals**
    - Complies with environmental, social, and governance (ESG) objectives
    - Supports integration into national Smart City initiatives and urban resilience programs
5. **Scalability and Replicability**
    - Modular system can be expanded across other high-risk districts with minimal reconfiguration
    - Can be licensed or adapted by other municipalities or countries

7.Data Strategy Framework

Data Strategy Overview

The AirSniff project employs a comprehensive data strategy designed to harness the power of IoT sensor data for enhanced fire prevention and air quality monitoring in the densely populated Pom Prap Sattru Phai district. This strategy is structured around five core dimensions: data quality, real-time data management, analytics, access and sharing, and data security and governance.

7.1. Data Quality Strategy

The Data Quality Strategy focuses on building a foundation of reliable and trustworthy data to support accurate decision-making and timely alerts. The project sets high standards for data accuracy, completeness, consistency, and timeliness. These principles ensure that every data point collected from sensors meets stringent quality criteria, thereby enabling public agencies and communities to act with confidence.

7.2. Real-time Data Management Strategy

The Real-time Data Management Strategy aims to enable rapid data transmission and processing to support immediate risk alerts and responses. This involves leveraging infrastructure capable of high-speed data flow, integrating real-time analytics engines, and automating alert notifications to stakeholders. The objective is to ensure that when a fire or hazardous air quality event is detected, relevant actors are informed in seconds, not hours.

7.3. Data Analytics Strategy

The Data Analytics Strategy is centered on turning raw sensor data into actionable insights that can inform long-term urban planning and preventative measures. By analyzing historical patterns, identifying correlations, and developing predictive models, the AirSniff system provides foresight into fire-prone areas and high-exposure zones, empowering agencies to allocate resources more effectively and prevent crises before they occur.

7.4. Data Access & Sharing Strategy

The Data Access and Sharing Strategy is designed to facilitate appropriate and secure data use across various stakeholder groups. It establishes differentiated access levels for user roles, including public agencies, community leaders, and researchers. Customized dashboards are provided to meet the unique needs of each group, and a framework for inter-agency data sharing ensures that critical information flows efficiently across organizations without compromising security or clarity.

7.5. Data Security & Governance Strategy

The Data Security and Governance Strategy ensures that all data activities are conducted under a secure and transparent governance framework. Clear roles and responsibilities are defined for each participant in the data lifecycle, with designated Data Stewards overseeing the verification, security, and compliance processes. The governance model emphasizes accountability, traceability, and alignment with data protection standards, reinforcing trust and sustainability in data operations.

8.Data Implementation Table Plan

Identify the Data Assets

- **Fire and PM2.5 Sensor Data:**
  Data collected from smoke detectors, heat detectors, and PM2.5 particulate sensors.
- **Alert Data:**
  Records of alert times, locations of detected abnormal heat spots, and the response actions from public agencies, private sectors, and the community.
- **Historical and Analytical Data:**
  Historical fire incident records, frequency of fire incidents by year/month/time periods, and trends in PM2.5 levels in the monitored areas.

8.1. Assign Roles and Responsibilities

8.1.1. Data Owners

The data ownership responsibilities are clearly defined to maintain data integrity and accountability across the system:

1. **Owner of Fire and PM2.5 Sensor Data:**
   Fire surveillance system engineers responsible for the accuracy of sensor data.

2. **Owner of Alert Data:**
   Field operations team responsible for recording and verifying alert notifications.
3. **Owner of Historical and Analytical Data:**
   Database and analytics managers responsible for maintaining historical fire incident data and conducting risk analysis.

8.1.2. Data Stewards:

Specific teams are designated as data stewards to ensure data quality and system performance:

1. **Sensor Data Stewards (Heat and Smoke):**
   Technical team responsible for verifying data accuracy and maintaining sensors.
2. **Alert Data Stewards:**
   Control center staff responsible for verifying alert data and recording operational actions.
3. **User Data Stewards:**
   User support team responsible for managing user accounts and data access rights.

4. **Historical and Analytical Data Stewards:**
   Data analysis team responsible for generating reports and statistics on historical fire incidents and conducting hotspot risk analysis.

8.2. Apply Policies and Standards

8.2.1. Data Quality Standards

To maintain high standards in data integrity and usability, the following criteria must be met:

1. **Accuracy:**
   Sensor data must maintain a minimum accuracy rate of 95%, with weekly calibration and verification.
2. **Completeness:**
   Sensor data must be at least 95% complete over time. Any missing data must be identified and corrected within 30 minutes.
3. **Consistency:**
   Data collected from multiple sensors within the same area must be consistent, and all sensors must follow the same measurement standards.
4. **Timeliness:**
   Data must be updated in real-time every 30 seconds and displayed on the dashboard within 3 minutes.
5. **Traceability:**
   All data must be traceable to its origin, including a record of changes and corrections.

8.2.2. Access Control Policy

Authorization:

1. **Administrator Level:**
   Full access to all data, including API and cloud configuration.
2. **Operational Level:**
   Access to alert data and emergency management functions via the dashboard.
3. **General User Level:**
   Access to public data and alerts relevant to their responsibility areas.
4. **API Level:**
   Access to data as per the purchased rights, controlled via API Key and defined rate limits.

Logging & Auditing:
All data access and changes must be automatically logged and periodically audited to ensure data security and accountability.

8.3. Implement Governance Processes

8.3.1. Data Quality Checks

- Test sensor performance under real-world conditions prior to installation to verify accuracy and device stability.
- Analyze sensor data to evaluate detection accuracy and minimize data errors.
- Perform weekly quality checks on alert data to ensure timely and accurate notifications.
- Verify the completeness of all incoming data to prevent loss or corruption that could affect analysis and alert reliability.

8.3.2. Data Issue Resolution

- Establish a standardized incident reporting process to enable prompt responses to data issues.
- Assign Data Stewards to review and resolve data issues within 48 hours to ensure data validity and availability.
- Track issue resolution progress and maintain detailed reports on errors, corrective actions, and preventive measures.

8.3.3. Compliance Monitoring

- Continuously monitor and record all data access and changes to prevent unauthorized access and strengthen data security.
- Prepare monthly or quarterly Data Governance summary reports for stakeholders, ensuring transparency in data management practices.

8.4. Metadata Catalog and Data Discoverability

8.4.1. Data Inventory Structure

8.4.1.1. Sensor Data Sources

- **Heat Sensors**
  - Location coordinates (latitude/longitude)
  - Temperature readings (°C)
  - Timestamp
  - Sensor ID and model information

    - Battery status
- **Smoke Sensors**
    - Location coordinates
    - Smoke density levels
    - Carbon monoxide readings (ppm)
    - Timestamp
    - Sensor ID and model information
    - Battery status

- **PM2.5 Sensors**
    - Location coordinates
    - PM2.5 concentration (μg/m³)
    - Timestamp
    - Sensor ID and model information
    - Battery status

8.4.1.2. Derived Data

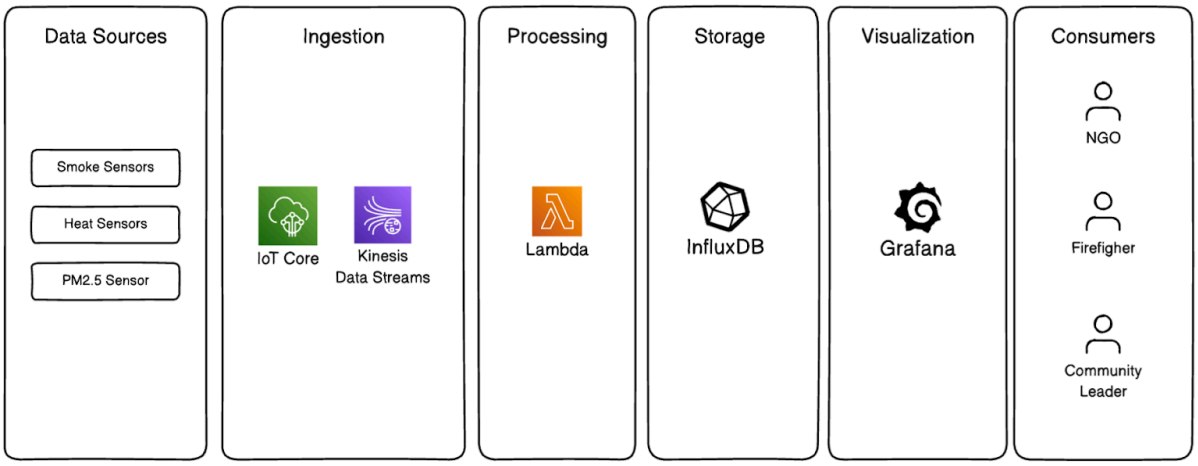
- **Fire risk assessment scores**
- **PM2.5 level classifications**
- **Alert history**

8.4.2. Metadata Framework

For each data asset, maintain:

- **Technical Metadata**
    - Data format (JSON)
    - Update frequency (real-time)
    - Data retention policy
    - Data quality metrics
- **Business Metadata**
    - Data owner (which team/organization)
    - Purpose description
    - Consumer access levels
    - Privacy classification
    - Relevant regulations
- **Operational Metadata**
    - Last update timestamp
    - Data freshness indicators
    - Processing pipeline status
    - Data lineage information

9.Data Architecture and Workflow



9.1. Technical Architecture

9.1.1. Data Sources

- **Heat Sensors**: Deployed throughout the community to detect abnormal temperature spikes
- **Smoke Sensors**: Early detection of smoke presence, critical for early warning
- **PM2.5 Sensors**: Monitor fine particulate matter for both fire detection and air quality assessment

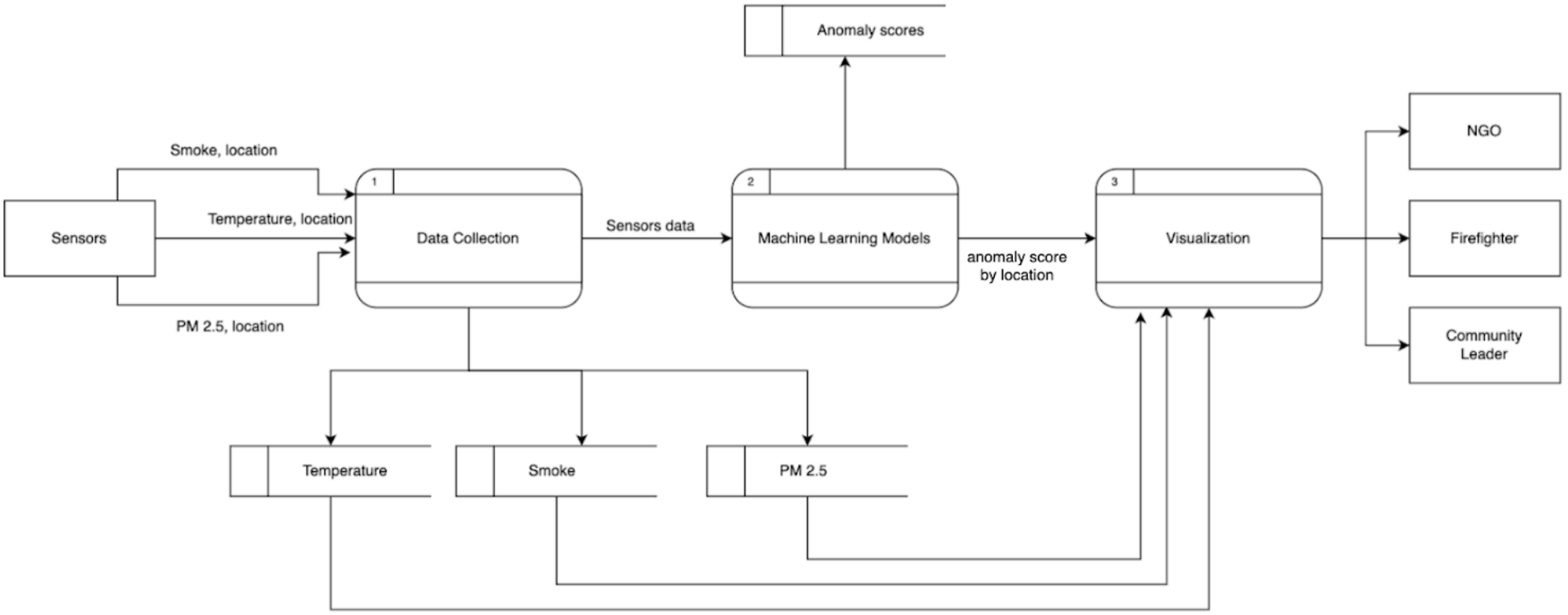
9.1.2. Data Pipeline

1. **Ingestion**:
   - AWS IoT Core: Securely connects all IoT devices, handles authentication and encryption
   - Amazon Kinesis Data Streams: Manages real-time data streaming from thousands of sensors
2. **Processing**:
   - AWS Lambda: Serverless functions analyze sensor data, detect anomalies, calculate risk levels, and trigger alerts when dangerous thresholds are exceeded
3. **Storage**:
   - InfluxDB: Time-series database optimized for sensor data, enables efficient storage and querying of historical and real-time measurements
4. **Visualization**:
   - Grafana: Creates customized real-time dashboards showing heat maps, trend graphs, sensor status, and alerts for different user groups

9.1.3. End Users

- **NGOs**: Access comprehensive community overview, system performance reports, and maintenance status
- **Community Leaders**: User-friendly dashboards with early warnings and emergency notifications via SMS/Line
- **Firefighters**: Mobile access to real-time data, sensor locations, access routes, and water sources

9.2. Data Flow Diagram



9.2.1. Key System Components

1. Sensors:
    - Smoke sensors with location data
    - Temperature sensors with location data
    - PM2.5 sensors with location data
2. Data Collection Module:
    - Receives input from all three sensor types
    - Segregates and categorizes the data (Temperature, Smoke, PM2.5)
    - Forwards consolidated sensor data to the Machine Learning module
3. Machine Learning Models:
    - Processes incoming sensor data
    - Generates anomaly scores to detect unusual patterns or emergency situations
    - Forwards analysis results to the Visualization module
4. Visualization Module:
    - Receives processed data from ML models
    - Also receives raw data streams from temperature, smoke, and PM2.5 databases
    - Transforms data into intuitive visual representations
    - Delivers customized dashboards to end users
5. End Consumers:
    - NGOs (primary customers)
    - Firefighting units
    - Community leaders

9.2.2. Data Flow Process

1. Environmental sensors continuously collect and transmit data with location information
2. The Data Collection module aggregates and categorizes this information
3. Machine Learning models analyze the data to identify potential fire hazards and generate anomaly scores
4. The Visualization module creates tailored real-time dashboards
5. End users receive customized views based on their specific needs and responsibilities

10.Solution

10.1. Smart Fire & Air Quality Monitoring Architecture

AirSniff utilizes intelligent sensor systems combined with real-time data processing to detect fire risks and air pollution (PM2.5) in high-risk areas. The key components are as follows:

Sensor Layer:
Installation of three types of sensors:

- **Heat Sensors**: Detect abnormal high temperatures
- **Smoke Sensors**: Detect smoke and gases
- **PM2.5 Sensors**: Measure fine particulate matter levels

Data Transmission & Processing:

- **AWS IoT Core**: Securely connects all sensors
- **Amazon Kinesis Data Streams**: Manages streaming data
- **AWS Lambda**: Analyzes data and triggers alerts when risk thresholds are exceeded

Storage & Visualization:

- **InfluxDB**: Stores data as a time-series database
- **Grafana**: Visualizes dashboards tailored to different user groups

10.2. Stakeholder Integration & Real-time Alerting

The AirSniff system integrates the operations of various agencies to ensure effective emergency response:

- **Government Agencies and Rescue Teams**:
  Receive data through dashboards and SMS with sensor location maps and access routes.
- **Communities and NGOs**:
  Receive alerts via user-friendly dashboards.
- **Automatic Alert System**:
  Alerts are triggered within 3 minutes after detection.
- **Device Status Monitoring**:
  Tracks the operational status of devices and issues notifications in case of malfunctions.

- **Daily Status Reports**:
  Help ensure the system's constant readiness.

10.3. Scalability & Flexibility

The system is designed for scalability and adaptability:

- **Expansion of Operational Areas**:
  If the project proves successful, it can be extended to inner-city slum communities in Bangkok, which share similar risk profiles.
- **Modular Architecture**:
  Supports adding new sensors and expanding the network without affecting the core system.
- **Area-Specific Dashboards**:
  Supports management and reporting separated by participating areas.

10.4. Security & Privacy Considerations

- **No Image or Video Collection**:
  Focus exclusively on sensor data.
- **Access Control System**:
  Access levels are assigned based on user roles.
- **Logging and Monitoring**:
  All data changes are recorded for auditing purposes.
- **PDPA Compliance**:
  Community consent is obtained, and only necessary data is collected.

10.5. Maintenance & Sustainability

- **Real-Time Device Status Monitoring**:
  Continuously checks the operational status of devices.
- **Alerts for Sensor Malfunctions**:
  Immediate notifications if any sensor stops working.
- **System and Data Management Team**:
  Handles maintenance, repairs, and accuracy verification.
- **Annual Maintenance Cost**:
  Estimated at 15–20% of the system’s total value.
- **Future Software and Hardware Upgrade Support**:
  Designed to accommodate future enhancements.

11.Monitoring and Evaluation

11.1. KPIs & OKRs

11.1.1. Metrics

- Accuracy of fire and PM2.5 detection: Maintain detection accuracy above 95%
- Alert transmission time: Within 3 minutes after a fire is detected
- Alert data accuracy: At least 95%

11.1.2. Business KPIs

- Reduce fire-related damage in the community by ≥ 50% within the first year
- Decrease health issues related to PM2.5 caused by fires in the long term
- Establish a sustainable collaboration system between the community and local agencies

11.1.3. Operational KPIs

- Fire detection system accuracy ≥ 95%
- Data must appear on the dashboard within 3 minutes after being received

11.2. Continuous Improvement – Key Functional Areas

11.2.1. Enhance Detection Accuracy

- Calibrate sensor sensitivity to match specific environmental conditions at each location
- Expand sensor installation based on event frequency and hotspot mapping
- Apply **Data Fusion** techniques to integrate multiple sensor inputs to reduce false alarms

11.2.2. Improve Smart Notification System

- Enable multi-channel alerting via LINE, and public address systems
- Develop a severity classification system for alerts such as “general alert,” “evacuation warning,” etc.

11.2.3. Community Co-Management

- Create reporting channels for residents to report fires or smoke via an app or QR code
- Develop a public dashboard for residents to view PM2.5 levels and community fire risk
- Conduct training activities for community members to help maintain devices

11.2.4. Advanced Data Use & Analytics

- Perform time-series analysis on historical fire incidents
- Analyze correlations between fire incidents, weather patterns, housing types, and local activities

- Provide **Open Data access** for other organizations to use in spatial and risk planning

11.2.5. Policy & Governance Updates

- Review **Data Privacy** and **PDPA** compliance policies at least once per year
- Improve system audit trails by logging user access, timestamps, and IP addresses

11.2.6. User-Driven Feedback Loop

- Conduct quarterly user satisfaction surveys
- Allow communities to submit feedback via dashboard or online forms, and incorporate it into system improvements
- Organize quarterly review meetings between technical teams, community leaders, and government agencies

12.Financial Projection & ROI

12.1. Cost Structure

12.1.1. Initial Costs (One-Time)

Cost Category	Amount (THB)	Description
Device Costs	2,135,000	Includes 120 Smoke Sensors, 180 Heat Sensors, 25 PM2.5 Sensors, and 25 Routers
Contingency Fund	1,500,000	Reserved for risk and unexpected expenses (10% of project budget)
Total Initial Investment	**3,635,000**	

Device Cost Breakdown

Device Type	Cost per Unit (THB)	Quantity	Total Cost (THB)
Smoke Sensor	8,000	120	960,000
Heat Sensor	5,000	180	900,000
PM2.5 Sensor	6,000	25	150,000
Router	5,000	25	125,000
Total Device Cost			**2,135,000**

12.1.2. Recurring Annual Costs

Cost Category	Amount (THB)	Percentage	Description
Operational Costs	370,000	7.13%	Includes installation for complex terrain, training
Personnel Costs	4,320,000	83.24%	Salaries for engineers, developers, support staff
AWS Cloud Services	500,000	9.63%	IoT Core, Kinesis, Lambda, EC2 for analytics
Total Annual Costs	**5,190,000**	**100%**	

Operational Costs Breakdown

Cost Area	Annual Cost (THB)	Description
Installation & Operations (Complex Terrain)	250,000	Field deployment and setup in challenging locations
Training and Workshops	120,000	Education for local users, safety, and maintenance
Total Operational Costs	**370,000**	

Personnel Costs Breakdown

Role	Monthly Salary (THB)	HC	Monthly Cost (THB)	Annual Cost (THB)	Description
IoT Engineer	25,000	2	50,000	600,000	Hardware integration, device support
Project Manager	65,000	1	65,000	780,000	Project planning and coordination
Infrastructure Engineer	60,000	1	60,000	720,000	Network setup, power systems
Software Developer	60,000	2	120,000	1,440,000	Backend, dashboard, alert system
Data Visualization	45,000	1	45,000	540,000	Dashboard reporting and analytics
Training & Support	20,000	1	20,000	240,000	Local user training and post-launch help
Total	—	**8**	**360,000**	**4,320,000**	

AWS Services

Service	Purpose	Included in Annual Cost (THB)
IoT Core	Secure device connectivity and message routing	
Kinesis Data Streams	Real-time data streaming from sensors	
AWS Lambda	Serverless compute for automation & alerts	
EC2 (InfluxDB, Grafana)	Hosting time-series database and dashboards	
Total AWS Cloud Cost	—	**500,000**

12.2. Financial Analysis

12.2.1. Key Financial Metrics

Metric	Value	Explanation
Total Investment	14,231,000 THB	Initial investment + 2 years of recurring costs (personnel, AWS, ops)
Total Revenue	15,422,222 THB	5,211,111 × 2 (annual payments) + 5,000,000 (one-time fee in Year 2)
Net Profit	1,191,222 THB	Total Revenue – Total Investment
ROI (2-Year)	8.37%	(1,191,222 / 14,231,000) × 100
Annualized ROI	4.10%	[(1 + 0.0837) ^ (1/2)] – 1
NPV @ 7% Discount	734,552 THB	Positive NPV = value-generating investment
IRR	21.53%	Internal rate of return (makes NPV = 0)
Payback Period	End of 2nd year	Break-even reached in second year (from cumulative cash flow)

Total Investment and Revenue (2-Year Project)

Category	Amount (THB)	Breakdown
Total Investment	**14,231,000**	Initial Investment: 3,635,000 + Operating Costs (2 years): 10,596,000
Total Revenue	**15,422,222**	One-time Fee (received in Year 2): 4,800,000 + Annual Fee (2 years): 10,622,222
Net Profit	**1,191,222**	Revenue – Investment

Pricing Structure

Fee Type	Customer Price (THB)	Cost Base (THB)	Actual Margin	Details
One-time Fee	4,800,000	3,635,000	32.05%	Lowered price; billed in Year 2; covers device & contingency
Split Payment	10,622,222	10,596,000	+0.25%	Covers 2-year Personnel, AWS, and Ops; no year negative
Total	**15,422,222**	**14,231,000**	**8.37% ROI (2-Year)**	**Balanced structure with all cash flows positive**

Cash Flow Analysis

Year	Inflow (THB)	Outflow (THB)	Net Cash Flow (THB)	Cumulative Cash Flow
0	0	3,635,000	–3,635,000	–3,635,000
1	**7,711,111**	**5,190,000**	**+2,521,111**	**–1,113,889**
2	**7,711,111**	**5,406,000**	**+2,305,111**	**+1,191,222**

12.3. Budget Allocation

12.3.1. Budget vs. Cost Analysis

Category	Amount (THB)	Notes
Total Project Cost	14,231,000	Latest cost based on 2-year operations
Our Cost (Company Responsibility)	14,231,000	All costs paid by company
Budget Coverage	105.40%	Budget is sufficient
Budget Surplus	768,999	Remaining after planned spending

12.3.2. Cost Responsibility Breakdown

Category	Amount (THB)	Notes
Devices	2,135,000	Now paid by Company (was Customer)
Contingency	1,500,000	One-time buffer
AWS Cloud Services	1,000,000	For 2 years
Personnel	8,856,000	2 years with 5% raise in Year 2
Operational	740,000	Installation + training (2 years)
Total	**14,231,000**	

12.3.3. Soft ROI (Intangible Benefits)

Category	Impact Description	Strategic Value	ROI Type	Estimated Value (THB)	Valuation Basis / Assumptions
Fire Risk Reduction	Early warnings help prevent property damage and potential life-threatening events	Reduces insurance claims, repair costs, downtime	**Quantified**	**300,000**	100 houses × 5% fire risk/year × 2 years = 10 incidents × 30,000 THB per incident
Improved Corporate Image	IoT/cloud adoption signals innovation and responsibility	Builds trust with government and public sectors	**Intangible**	–	
Enhanced Safety	Real-time alerts improve employee and community safety	Strengthens stakeholder confidence and community safety	**Intangible**	–	
Operational Efficiency	IoT reduces manual inspections and routine checks	Frees up workforce time for core tasks	**Intangible**	–	
Scalability for Growth	Cloud infrastructure allows quick expansion to new areas	Reduces future infrastructure & deployment cost	**Intangible**	–	
Data-Driven Planning	Sensor data supports high-risk zone analysis & long-term planning	Enables better decision-making and policy development	**Intangible**	–	

13. Risk Mitigation and Issue Management

13.1. Strategic & Regulatory Risks

13.1.1. Strategic Risks

Risk	Risk Level	Impact	Mitigation Approach
Community Acceptance	High	Communities may not understand system usage or see its benefits, resulting in lack of participation and equipment maintenance	• Conduct training and workshops to help communities understand system benefits • Develop easy-to-understand alert systems • Establish community leaders as key coordinators
Failure to Achieve Planned Goals	Medium	May not be able to reduce fire damage according to targets (≥50%)	• Continuously monitor and evaluate results • Adjust strategies and implement additional measures if goals aren't met • Conduct in-depth problem analysis to improve efficiency
Rapid Technological Changes	Medium	Sensor technology and IoT systems may become outdated quickly	• Design systems to support future upgrades • Use open and adaptable platforms • Allocate budget for technology upgrades

13.1.2. Regulatory Risks

Risk	Risk Level	Impact	Mitigation Approach
Data Privacy Regulations	Medium	Potential issues with collecting location data and installation in private areas	• Design systems to collect only necessary data • Obtain community consent before installation • Comply with Personal Data Protection Act
Equipment Licenses and Standards	Low	Sensor equipment may require safety standard certification	• Use standardized equipment with proper certification • Verify standard requirements and licenses before purchasing
Frequency Usage Limitations	Low	Possible restrictions on frequency usage for wireless data transmission	• Check NBTC regulations regarding IoT devices • Use authorized communication technologies
Changes in PM2.5 Measurement Standards	Medium	Air quality measurement standards may change in the future	• Regularly monitor changes in standards • Design systems that can adjust measurement criteria according to new standards

13.2. Financial Risk

The table below outlines the primary financial risks, their likelihood, impact, and corresponding mitigation strategies.

Risk	Description	Likelihood	Impact	Mitigation Strategy
Budget Overrun	Unforeseen increases in hardware, software, or labor costs.	Medium	High	Allocate a 10% contingency budget and monitor expenses through monthly reviews.
Deployment Delays	Installation, testing, or development may exceed the scheduled timeline, increasing labor costs.	High	Medium	Apply milestone-based payments, use agile development cycles, and maintain a strict project timeline.
Limited System Adoption	Low user engagement from agencies or community members, affecting cost-effectiveness.	Medium	High	Provide hands-on training, design user-friendly interfaces, and engage stakeholders through workshops.
Exchange Rate and Supply Chain Fluctuations	Imported components may be affected by currency changes or delivery delays.	Low	Medium	Source parts locally where possible and secure fixed-price contracts with suppliers.
Unclear ROI	Difficulty quantifying the financial return on improved safety and air quality.	Medium	Medium	Use qualitative and quantitative indicators (e.g., fire incident reduction, health impact analysis) in evaluation reports.

13.3. Data Privacy, Data Security, and Compliance

13.3.1. Data Privacy

13.3.1.1. Data Types Collected

AirSniff collects environmental sensor data including PM2.5 levels, smoke, temperature, and sensor installation location. All data collected is categorized as non-personal data (Non-PII). No images, sounds, or personally identifiable information (PII) of individuals are collected.

13.3.1.2. De-identification

Although location coordinates of sensor installations are collected, they are not linked to any individual. Data displayed on the Dashboard is aggregated and does not disclose identifiable individual information.

13.3.1.3. Purpose Limitation

The data is used exclusively for fire alerting, air quality monitoring, and spatial risk analysis. It will not be used for unrelated marketing or commercial purposes.

13.3.1.4. Consent Mechanism

For installations within community areas, consent must be obtained from community representatives or local organizations, in accordance with community rights principles. Clear explanations of the installation's purpose must be provided.

13.3.1.5. Data Subject Rights

Stakeholders (e.g., communities, local authorities) have the right to access historical alert records, request deletion of sensor data points, or inquire about the data usage through transparent channels.

13.3.2. Data Security

13.3.2.1. Access Control

Role-Based Access Control (RBAC) is implemented, assigning different access permissions to government officers, system engineers, and community leaders based on the principle of Least Privilege. User authentication is required before accessing the system.

13.3.2.2. Monitoring & Audit Log

The system logs all access, data read/write activities, and alert management actions for auditing and violation prevention. Authorization levels include:

- Administrator: Full access and Cloud settings
- Operations Level: Access to alert data and emergency management via Dashboard
- General User: Access only to public data and local alerts

13.3.2.3. Incident Response Plan

In case of data breaches or unauthorized access, the system issues automatic alerts and reports incidents to relevant authorities immediately.

13.3.3. Compliance

13.3.3.1. Applicable Laws

AirSniff is designed to comply with Thailand's Personal Data Protection Act (PDPA) B.E. 2562 (2019). If expanded internationally, compliance with GDPR or other local regulations will be considered.

13.3.3.2. Standards Adopted

The system adopts ISO/IEC 27001 (Information Security Management) and NIST CSF frameworks for information security governance.

13.3.3.3. Data Roles & Accountability

Data roles are clearly defined: Data Controller (Project Owner), Data Processor (Development Team), and Community Representative (collaborating with local authorities).

13.3.3.4. DPIA

For installations near sensitive areas like schools or hospitals, a Data Protection Impact Assessment (DPIA) will be conducted prior to installation to assess impacts on individual rights and freedoms.

14. Monetization Models

14.1. Anonymized Data Products

AirSniff collects large volumes of environmental data from sensors, which can be anonymized and transformed into valuable data products. These datasets exclude any personally identifiable information and are suitable for organizations conducting large-scale analysis on environmental trends, urban planning, and public health research. By offering this data in a secure and privacy-conscious format, AirSniff creates a recurring revenue opportunity while contributing to broader urban knowledge ecosystems.

14.1.1. Premium Analytics Reports

To meet the growing demand for strategic insight, AirSniff will provide comprehensive quarterly and annual reports that summarize environmental conditions across monitored

urban areas. These reports include detailed trend analyses of air quality levels, fire incidents, and seasonal variations. Urban risk assessment profiles are developed to support city planners in infrastructure design and hazard mitigation. Additionally, tailored report packages are available for academic and research institutions interested in tracking long-term health and environmental patterns in urban communities.

14.2. Value-Added Services

14.2.1. Risk Assessment Consulting

AirSniff offers consulting services that use historical sensor data to perform localized environmental risk assessments. These services support urban development projects by evaluating fire and air quality risks in specific communities. From these assessments, customized safety recommendations are generated based on unique geographic and demographic factors, helping stakeholders make informed decisions that enhance public safety.

14.2.2. Predictive Modeling

Advanced predictive tools are another layer of AirSniff's service model. The platform can develop fire risk prediction models for insurance companies, enabling better underwriting decisions and risk pricing. For health organizations, PM2.5 forecast services can help anticipate harmful exposure periods and plan public advisories. AirSniff also designs resilience scoring systems for development agencies, which assess a community's vulnerability and readiness based on historical and real-time environmental data.

14.3. Data Partnerships

14.3.1. Research Collaborations

AirSniff actively seeks collaboration with academic institutions and research centers investigating urban health and environmental safety. These partnerships involve sharing relevant datasets and co-developing studies focused on climate impact, air quality, and respiratory health. By contributing data and domain expertise, AirSniff supports evidence-based policymaking and enhances the scientific understanding of urban risk factors.

14.3.2. Cross-Sector Integrations

To maximize utility, AirSniff is designed for integration with broader smart city platforms. This enables real-time data sharing with municipal monitoring systems, disaster

response operations, and public dashboards. Collaborations with healthcare providers open channels for delivering real-time environmental health alerts, while partnerships with insurance firms facilitate the development of risk-based pricing models grounded in hyperlocal environmental data. These integrations strengthen urban resilience and create new commercial value through applied data science.

15.Appendix

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