ID: SDI003

Theme #3

TEAM ROBO MECH X-5

Crafting Sustainable Solution for Cleaner, Healthier Air in Delhi

Problem Statement: What innovative, technology-driven solutions can be developed and integrated with existing policies to effectively mitigate air pollution in Delhi, ensuring both scalability and long-term sustainability?

Title:-

IoT-Enabled Autonomous Mobile Robot with Modular Filtration Systems for Air Pollution Mitigation

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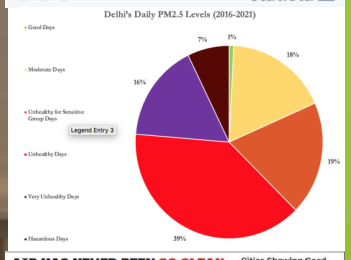
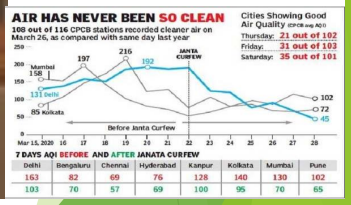
Introduction

Problems

- **Delhi ranks among the most polluted cities in the world.**
- **Dangerous air quality levels lead to respiratory illnesses, reduced visibility, and public health emergencies.**
- **Particulate matter (PM2.5 & PM10) regularly exceeds safe limits set by WHO**

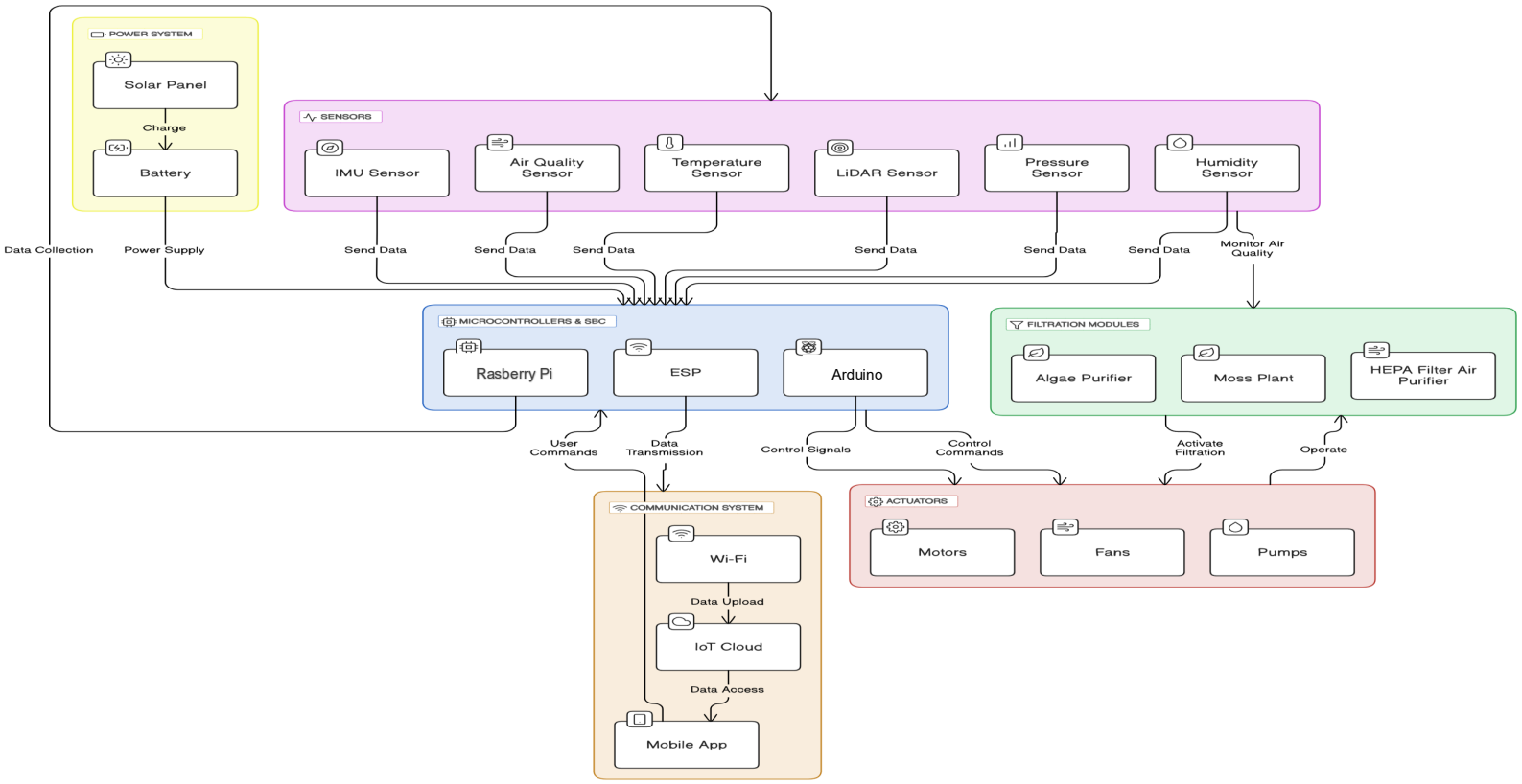


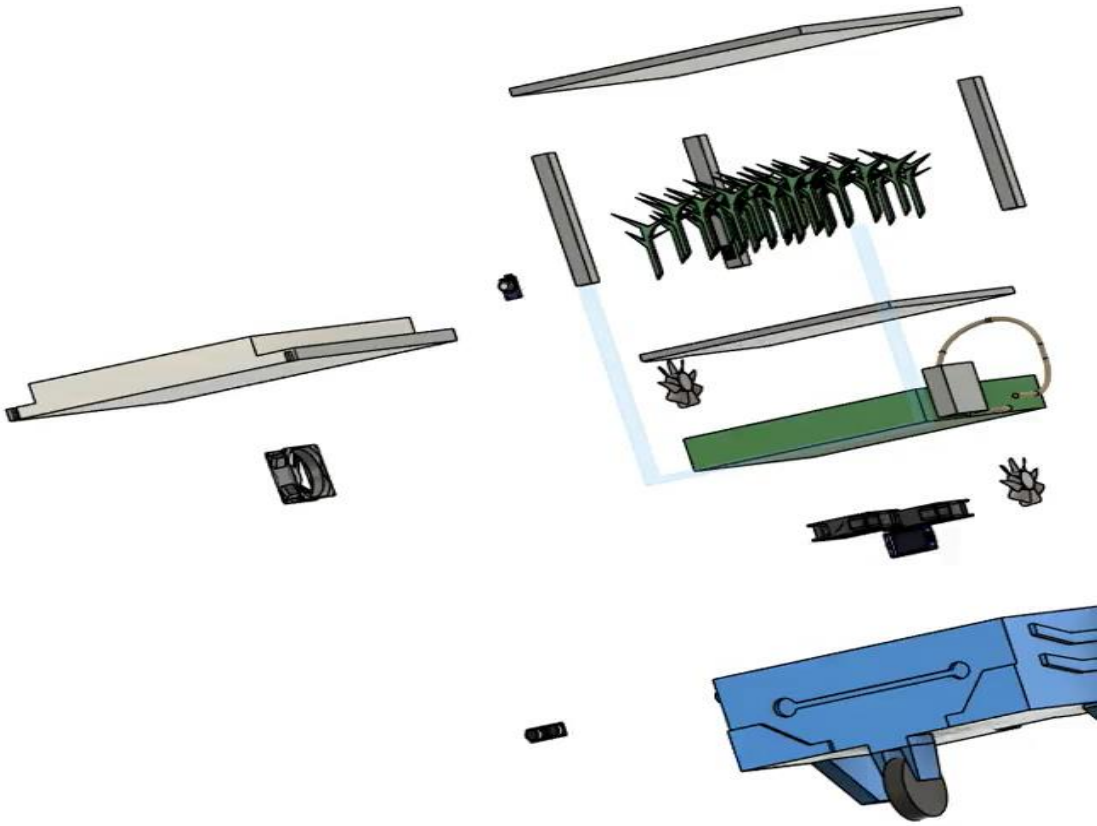


Proposed Solution

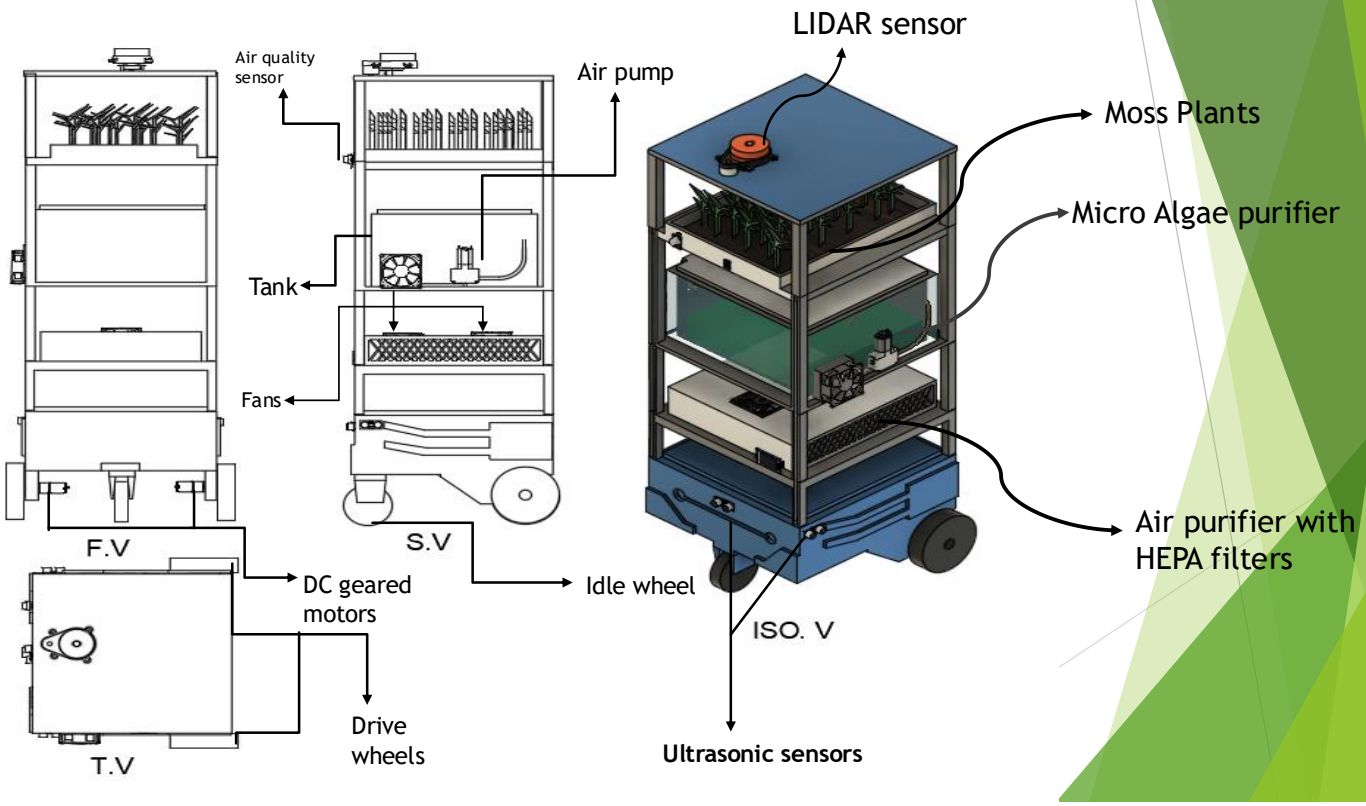
Developing an IoT-Enabled Autonomous Mobile Robot to actively filter air with modular system, monitor air quality, and contribute to sustainable, scalable pollution mitigation.

Flow chart of IoT-Enabled Autonomous Mobile Robot with Modular Filtration Systems





Model Représentation: 3D & 2D Perspectives

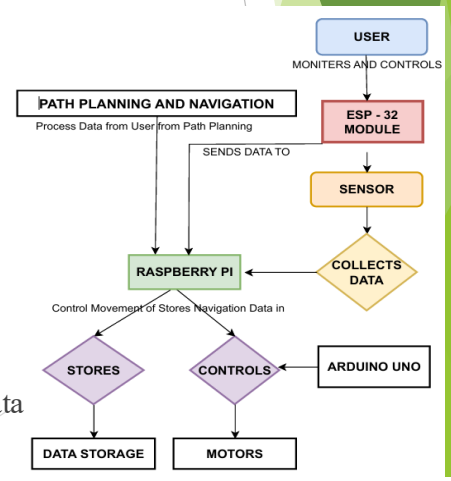


Innovation & Technology Utilization

- **Key Innovations:-**
- **IoT Integration:** Real-time air quality monitoring and mobile app control
- **Autonomous Navigation:** SLAM and pathfinding algorithms (A*, Dijkstra)
- **Modular Filtration System:**
  - **Algae Module:** Absorbs CO_2 through photosynthesis
  - **Moss Module:** Natural air purification
  - **HEPA Filtration:** Captures fine particulate matter (PM2.5, PM10)



- **Core Components:-**
- **ESP Microcontroller:** Manages sensors and IoT functions
- **Arduino:** Operates pumps, fans, and motors
- **Raspberry Pi:** Handles navigation, path planning, sensor fusion, and data aggregation

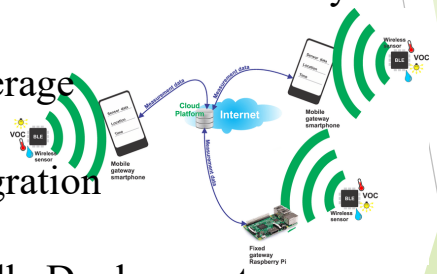


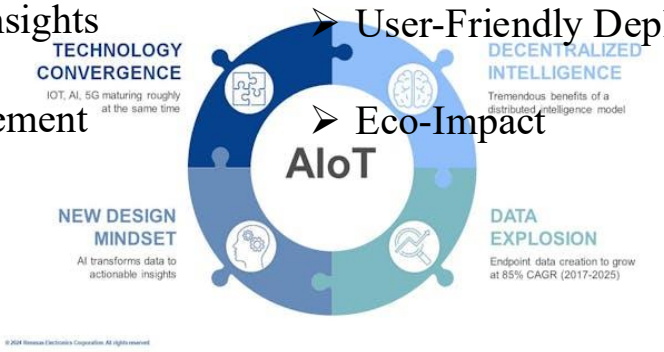
Deployment strategy

- ✓ Targeting High-Pollution Zones
- ✓ Adaptive Filtration Strategy
- ✓ Predictive Data Analysis
- ✓ Smart Public Reporting
- ✓ Data-Driven Insights
- ✓ Citizen Engagement

Market Advantages

- ➢ Cost Efficiency
- ➢ Enhanced Purification Efficiency
- ➢ Wider Coverage
- ➢ Policy Integration
- ➢ User-Friendly Deployment
- ➢ Eco-Impact





Comparison with Conventional Air Purifiers and Algae-Based Solutions

Criteria	Conventional Air Purifiers	Algae-Based Purifiers	Proposed IoT-Enabled Autonomous Modular Robot
Mobility	Stationary, fixed to one location	Stationary, dependent on environmental setup	Fully autonomous, mobile for hotspot targeting
Air Cleaning Modules	HEPA filters only, limited to particulate matter	Effective in CO_2 absorption but slow	Triple-layer system: HEPA filters, algae, and moss plants
Adaptability	No adaptability to pollution hotspots	Fixed algae setup	AI-driven navigation for hotspot identification
Data Monitoring	Limited or no real-time data	Minimal monitoring capabilities	IoT-enabled real-time tracking and reporting
Environmental Impact	High energy consumption	Eco-friendly but less efficient for fine particles	Sustainable hybrid with solar integration and optimized energy use
Scalability	Difficult to scale across multiple locations	Space-dependent, complex deployment	Modular, scalable, and easily deployable in urban environments
Maintenance	Regular filter replacements	Requires algae care and water management	Predictive maintenance with AI alerts