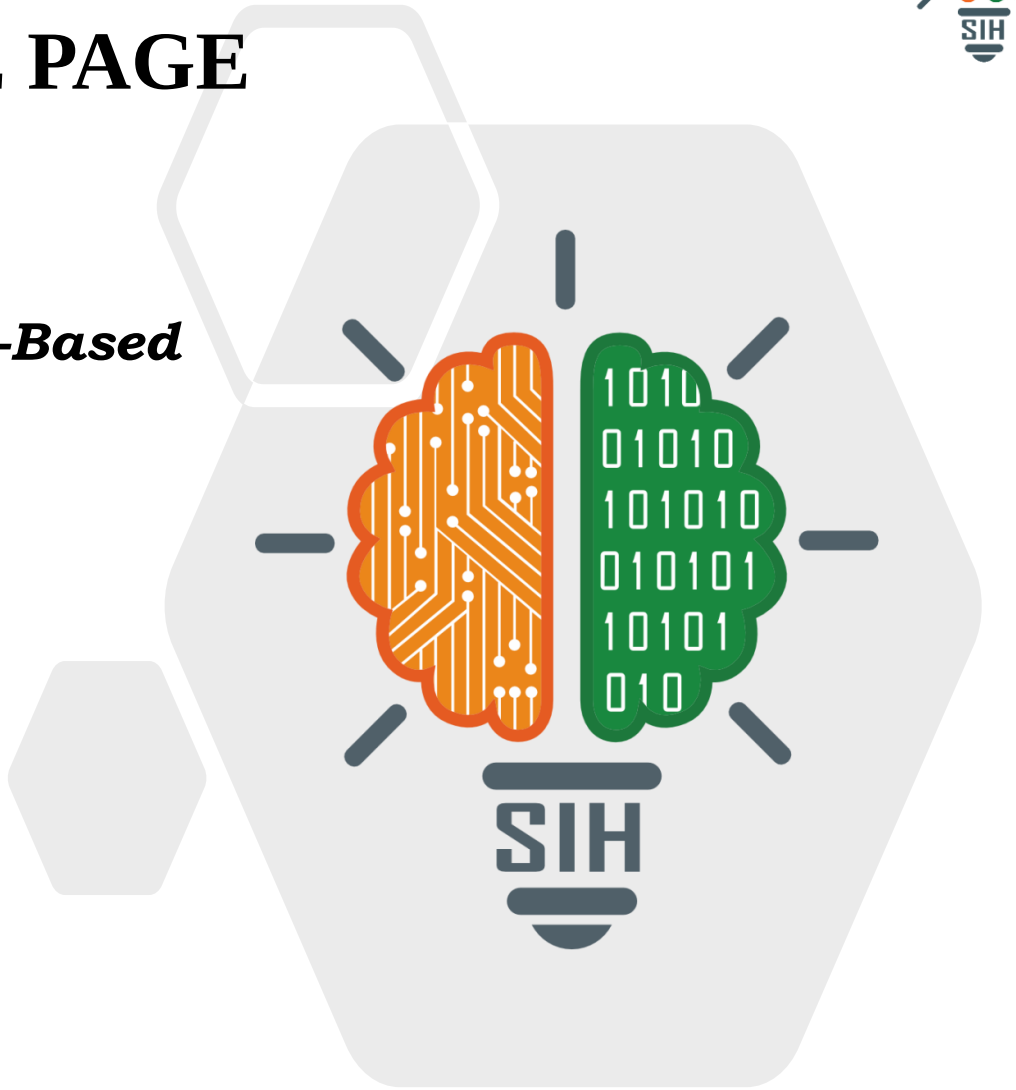
SMART INDIA HACKATHON 2024

TITLE PAGE

- *Problem Statement ID -* **1583**
- *Problem Statement Title -* ***Condition-Based Monitoring And Maintenance System***
- *Theme -* Miscellaneous
- *PS Category -* Hardware
- *Team Name -* *PrimeHex*
- *Team ID –* RMKSIH24HW021



PrimeHex

IDEA TITLE

SMART INDIA HACKATHON 2024

Proposed solution

- **Sensor Data Collection**: Sensors on TBFs capture operational data during drills, providing essential insights into fan condition.
- **Condition-Based Maintenance:** The system shifts from scheduled maintenance to condition-based, ensuring maintenance is performed only when needed.
- **AI-Powered Alerts**: The AI system sends alerts for deviations, optimizing maintenance and reducing manpower and operational risks.

Addressing the problem

- **Efficient Data Collection:** Sensors on TBFs gather precise operational data during drills, reducing the need for manual inspections.
- **Optimized Maintenance:** Condition-based maintenance eliminates unnecessary routine checks, focusing on actual equipment needs.
- **Risk and Cost Reduction:** The AI system alerts for deviations, minimizing manpower usage and safety risks, especially in high-risk environments.

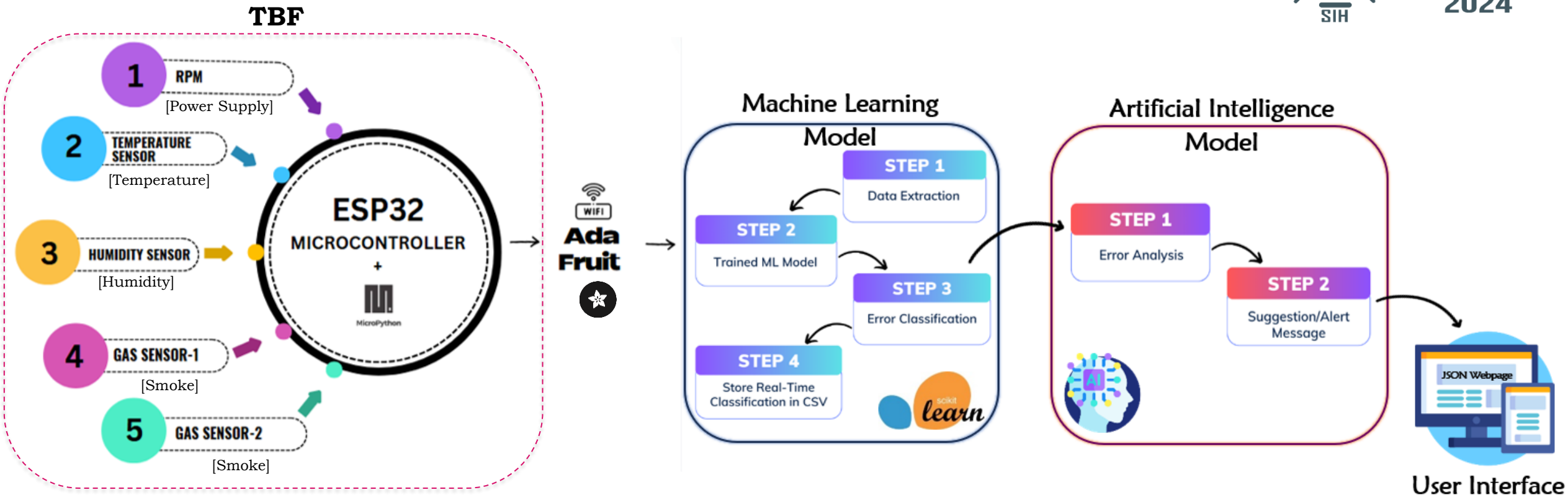
Uniqueness of the solution

- **Targeted Maintenance Approach:** Shifting from scheduled to condition-based maintenance ensures resources are used only when necessary, reducing waste.
- **Real-Time AI Insights:** The integration of AI provides predictive maintenance alerts, offering proactive solutions instead of reactive fixes.
- **Cost and Risk Efficiency**: Minimizes operational costs and safety risks by optimizing manpower deployment and reducing high-risk manual inspections.

PrimeHex

TECHNICAL APPROACH

SMART INDIA HACKATHON 2024



Technology used

- ***Micropython***
- ***Sklearn library***
- ***LLM Model***
- ***Frontend with Flask (Interface)***

PrimeHex

FEASIBILITY AND VIABILITY

SMART INDIA HACKATHON 2024

Feasibility

- **Hardware Selection**
- **Data Processing:** Store and manage data with Adafruit Cloud.
- **AI/ML Integration:** Employ AI/ML to analyze data and detect faults.
- **Development and Integration:** Program and integrate components with MicroPython.
- **Scalability**

Viability

- **Cost Efficiency:** Initial costs are balanced by significant long-term savings.
- **Return On Investment :** High return through cost reductions and increased asset value
- **Energy Savings:** Continuous monitoring cuts energy use and utility bills.
- **Automation**
- **Enhanced Safety**
- **Flexible**

Challenges & Overcomes

- **ML Algorithm Selection and Training**: Beginning with simpler models, then evolve to more complex ones using diverse, well labeled data for improved predictions.
- **Integration and Maintenance**: Design modular system with API-based communication and automated health monitoring for easy updates and efficient maintenance
- **Enhanced Detection**: Utilize ensemble learning methods and adjust dynamic thresholds to minimize false alarms and improve overall fault detection performance

PrimeHex

IMPACT AND BENEFITS

SMART INDIA HACKATHON 2024

Impact

- ***Predictive Maintenance:*** AI-driven error detection supports proactive maintenance, reducing downtime and emergency situations.
- ***Efficient Resource Allocation:*** Early issue identification allows better prioritization and resource management for maintenance teams.
- ***Data-Driven Strategies:*** Error data informs predictive maintenance, leading to improved long-term system performance and reliability.

Benefits

- ***Enhanced Safety:*** Early error detection prevents potential hazards, ensuring tunnel safety during emergencies.
- ***Operational Continuity:*** Regular checks and quick repairs maintain uninterrupted tunnel ventilation system performance.
- ***Extended Equipment Lifespan:*** Prevents excessive wear and tear, prolonging the life of the fans.

PrimeHex

RESEARCH AND REFERENCES

SMART INDIA HACKATHON 2024

- A Review of Gas Measurement Practices and Sensors for Tunnels

https://www.mdpi.com/1424-8220/23/3/1090

- IoT-Based Temperature Monitoring and Automatic Fan Control Using ESP32

https://www.irejournals.com/paper-details/1705183

- Enhancing Tunnel Fan Reliability Through Advanced Factory Acceptance Test (AFAT)

https://www.krugerfan.com/public/uploads/cs-pdf-20242024202420240505090910100505333.pdf

- Condition-Based Maintenance Using Machine Learning and Role of Interpretability

https://link.springer.com/article/10.1007/s13198-022-01843-7