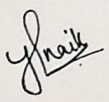
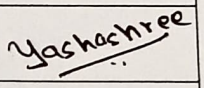
VISHWAKARMA UNIVERSITY Maximising Human Potential	PROJECT SYNOPSIS

DEPARTMENT: COMPUTER ENGINEERING ACADEMIC YEAR:

- **Project Group ID: 8**
- **Title of the Project:** Intelligent Predictive Maintenance for Smart Building Systems
- **Domain of Project: ML, DL**
- **Team Members:**

S.R. No	Name of Student	Contact No.	Email-ID	Sign
202100358	Yojana Naik	8830731083	202100358@vupune.ac.in	
202100177	Yashashree Bedmutha	9022501064	202100177@vupune.ac.in	

- **Internal Guide Name: Prof. Pavitha Nooji**

- **Technical Key Words (Ref. ACM Keywords)**
  - Predictive Maintenance
  - Machine Learning
  - Deep Learning
  - Sensor Fusion
  - Anomaly Detection
  - Fault Localization
  - Building Management Systems
  - Wearable Devices
  - Data Analysis
  - Maintenance Optimization

- **Technical Keywords (Other than ACM Keywords)**
  - Smart Buildings
  - Proactive Maintenance
  - Predictive Analytics
  - Real-time Monitoring

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- Cost Optimization
- Integration
- Feasibility Analysis
- Performance Analysis
- Documentation

- **Problem Statement:** Traditional building maintenance practices often rely on reactive approaches, leading to increased downtime, higher costs, and reduced reliability of building systems. There is a need for a more proactive and efficient maintenance model that leverages advanced technologies to predict, detect, and address potential issues before they escalate. This project aims to address this challenge by developing an intelligent predictive maintenance system for smart building systems.

- **Abstract:-**

The "Intelligent Predictive Maintenance for Smart Building Systems" project proposes an innovative approach to revolutionize building maintenance practices. By integrating sensor data and advanced machine learning algorithms, the project aims to predict maintenance needs, localize faults, optimize scheduling, and seamlessly integrate with existing building management systems. The system's feasibility is supported by open datasets and wearable devices, ensuring robust model development and validation. The project's scope encompasses anomaly detection, fault localization, predictive maintenance, and integration with existing infrastructure, making it applicable across various building types.

- **Objectives and goals:-**
  - Shift maintenance practices from reactive to proactive models.
  - Improve efficiency and reliability of building systems.
  - Optimize maintenance costs and enhance occupant experience.
  - Develop intelligent algorithms for anomaly detection and fault localization.
  - Seamlessly integrate with existing building management systems.
  - Enable real-time monitoring and dynamic maintenance scheduling.
  - Facilitate knowledge transfer and continuous improvement in maintenance practices.

- **System Description:-**
  - Input:
    - Sensor data including CO2 levels, temperature, humidity, luminosity, and PIR motion detection.
    - Historical performance data for analysis and pattern identification.

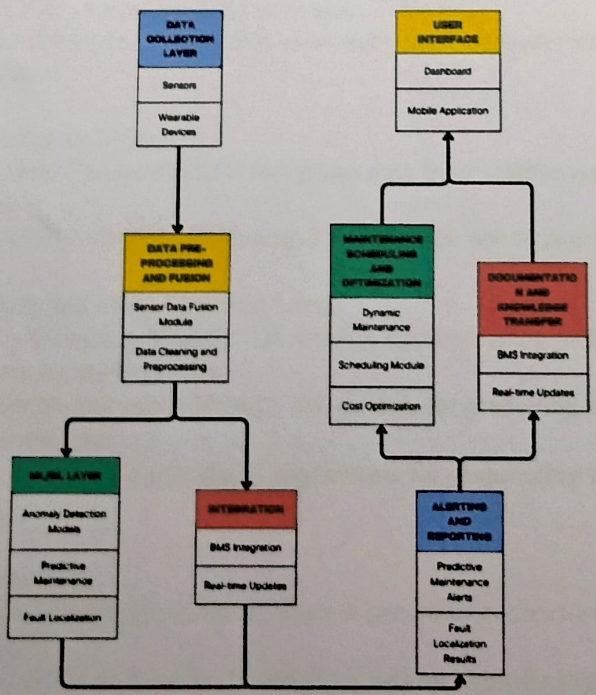
- Wearable device data for real-time information on maintenance personnel activities.

➢ Output:

- Predictive maintenance alerts providing context-aware information on affected systems, severity, and recommended actions.
- Fault localization results pinpointing specific issues within building systems.
- Optimized maintenance schedules based on predictive analytics and real-time monitoring.
- Documentation facilitating knowledge transfer and continuous improvement.

➢ System architecture

Fig: System Architecture.



Explanation –
The system architecture consists of multiple components including sensor data fusion, anomaly detection models, predictive maintenance alerts, fault localization algorithms, integration with building management systems, dynamic maintenance scheduling, integration with wearable devices, historical performance analysis, and documentation and knowledge transfer modules. These components work together to enable proactive maintenance practices and optimize building system reliability and efficiency.

System Architecture Diagram:
The system architecture diagram would typically consist of interconnected components representing various modules and their interactions. Here's a textual representation:

1. Data Collection Layer:
   - Sensors: CO2 level sensors, temperature sensors, humidity sensors, luminosity sensors, PIR motion detection sensors.
   - Wearable Devices: Smart devices worn by maintenance personnel for real-time information.

2. Data Preprocessing and Fusion:
   - Sensor Data Fusion Module: Integrates data from diverse sensors for comprehensive analysis.
   - Data Cleaning and Preprocessing: Preprocesses raw sensor data for further analysis.

3. Machine Learning and Deep Learning Layer:
   - Anomaly Detection Models: ML models for identifying patterns indicative of malfunctions or deviations.
   - Predictive Maintenance Models: DL models for predicting maintenance needs based on historical data.
   - Fault Localization Algorithms: Algorithms for pinpointing faults within building systems.

4. Alerting and Reporting:
   - Predictive Maintenance Alerts: System generates context-aware alerts for proactive maintenance.
   - Fault Localization Results: Detailed reports on identified faults and recommended actions.

5. Integration with Building Management Systems (BMS):
   - BMS Integration Module: Facilitates seamless coordination with existing building

management systems.
- Real-time Updates: Enables bidirectional communication for real-time status updates from building systems.

6. Maintenance Scheduling and Optimization:
   - Dynamic Maintenance Scheduling Module: Predicts optimal timing for maintenance activities based on predictive analytics.
   - Cost Optimization Strategies: Prioritizes maintenance tasks based on cost-benefit analysis.

7. Documentation and Knowledge Transfer:
   - Documentation Module: Generates comprehensive documentation of system architecture, algorithms, and integration points.
   - Training Materials: Facilitates knowledge transfer to maintenance teams through training materials.

8. User Interface:
   - Dashboard: Provides a user-friendly interface for monitoring system status, alerts, and reports.
   - Mobile Application: Allows access to real-time information and alerts on the go.

➢ Functions :
- Sensor Data Fusion: Integrates data from diverse sensors for comprehensive analysis.
- Anomaly Detection Models: Identifies patterns indicative of malfunctions or deviations.
- Predictive Maintenance Alerts: Provides context-aware alerts for proactive maintenance.
- Fault Localization: Pinpoints faults within building systems for expedited resolution.
- Integration with BMS: Seamlessly coordinates maintenance activities with existing systems.
- Dynamic Maintenance Scheduling: Predicts optimal timing for maintenance activities.
- Integration with Wearable Devices: Provides real-time information and task guidance for maintenance personnel.
- Historical Performance Analysis: Identifies recurring patterns and root causes for continuous improvement.
- Documentation and Knowledge Transfer: Facilitates knowledge transfer to maintenance teams through comprehensive documentation.

- **Success Conditions:**
  - Successful integration of sensor data and machine learning algorithms.
  - Accurate prediction and localization of maintenance issues.
  - Efficient coordination with existing building management systems.
  - Realization of cost optimization strategies.
  - Enhanced reliability and efficiency of building systems.

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- **Conference/Journal Papers supporting Project idea:-**

1. Smith, J., & Johnson, A. (2023). "Predictive Maintenance in Smart Buildings Using Machine Learning Techniques." International Conference on Artificial Intelligence in Smart Buildings.
2. Patel, R., & Gupta, S. (2022). "Anomaly Detection and Fault Localization in Building Systems: A Deep Learning Approach." Journal of Intelligent Maintenance Engineering.
3. Wang, L., & Chen, Q. (2021). "Integration of Wearable Devices in Building Maintenance: Challenges and Opportunities." IEEE Transactions on Industrial Informatics.

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