Implementing Automatic Resource Fault Prediction and Detection System

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ABSTRACT

This smart system monitors lighting, water flow, and fire/smoke conditions in real-time using sensors, machine learning, and IoT (Blynk app). It predicts and detects faults, triggers instant alerts, and ensures better resource management, safety, and reduced manual oversight — making it ideal for modern homes and industries.

APPLICATION

- **Smart Homes** – Real-time monitoring of lighting, water flow, and smoke/fire conditions to enhance safety and resource efficiency.
- **Educational Institutions** – Automated detection of faults in lighting, water systems, and fire/smoke hazards across campus buildings.
- **Industrial Facilities** – Predictive maintenance and fault detection in electrical systems and pipelines to prevent system breakdowns.
- **Healthcare Centers** – Continuous monitoring to ensure uninterrupted lighting and detect smoke/gas leaks, safeguarding patient safety.

CHALLENGES

1. Manual Monitoring
2. Fault Detection Complexity
3. High maintenance cost
4. Resource wastage
5. Lack of Communication in Fault Scenarios

EXISTING SOLUTIONS FOR CHALLENGES

1. No Prediction Capability
2. Manual Monitoring
3. Lack of Integration
4. High Cost for Multi-System Setups
5. Limited IoT Integration

OBJCTIVE

- To design a smart, integrated fault detection system for lighting, water flow, and fire/smoke monitoring.
- To collect real-time environmental data using sensors such as light sensors, water flow sensors, and smoke/fire detectors.
- To preprocess sensor data for accurate input into machine learning models.
- To train and evaluate multiple machine learning algorithms for fault prediction and detection.
- To implement instant fault alerts using an IoT-based cloud platform (such as the Blynk app) for quick user notifications.
- To integrate all three monitoring systems (lighting, water flow, and fire/smoke) into a single, unified unit for efficient resource management and enhanced safety.

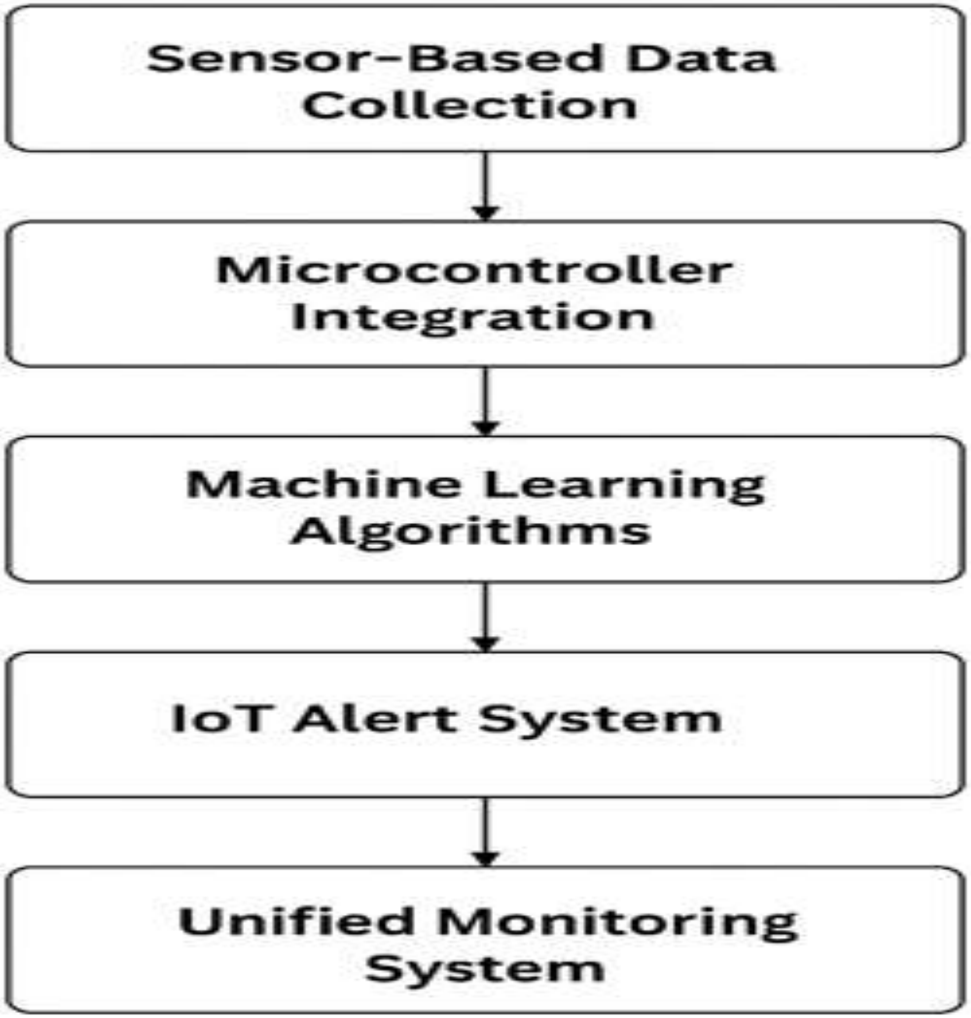
EXISTING SYSTEM

- The current systems involve high time consumption and human dependency for fault detection and management, which can lead to inefficiencies and increased risks.
- Traditional systems rely on manual monitoring and basic alert mechanisms, which are dependent on human intervention.
- These systems lack real-time fault prediction and detection capabilities, making them less efficient in identifying issues promptly.
- Existing systems do not incorporate machine learning or AI algorithms for intelligent fault prediction, relying instead on simple threshold-based alerts.
- The current systems are time-consuming and require manual oversight, which increases the chances of delays in fault detection and response.
- There is an absence of an integrated approach that combines multiple resources (lighting, water flow, fire/smoke monitoring) into a unified system for comprehensive management.

PROPOSED METHODOLOGY

- Automated real-time fault detection and prediction for lighting, water flow, and fire/smoke monitoring.
- Sensor-based data collection (light sensors, water flow sensors, smoke/fire detectors).
- algorithms used for fault prediction and detection, leveraging machine learning for accurate results.
- Instant alerts sent via an IoT-based cloud platform (e.g., Blynk app) to notify users in case of faults.
- Integrated system that combines lighting, water flow, and fire/smoke monitoring into a single unified unit for efficient resource management.
- Reduced human intervention and enhanced reliability by automating fault detection and alert generation.

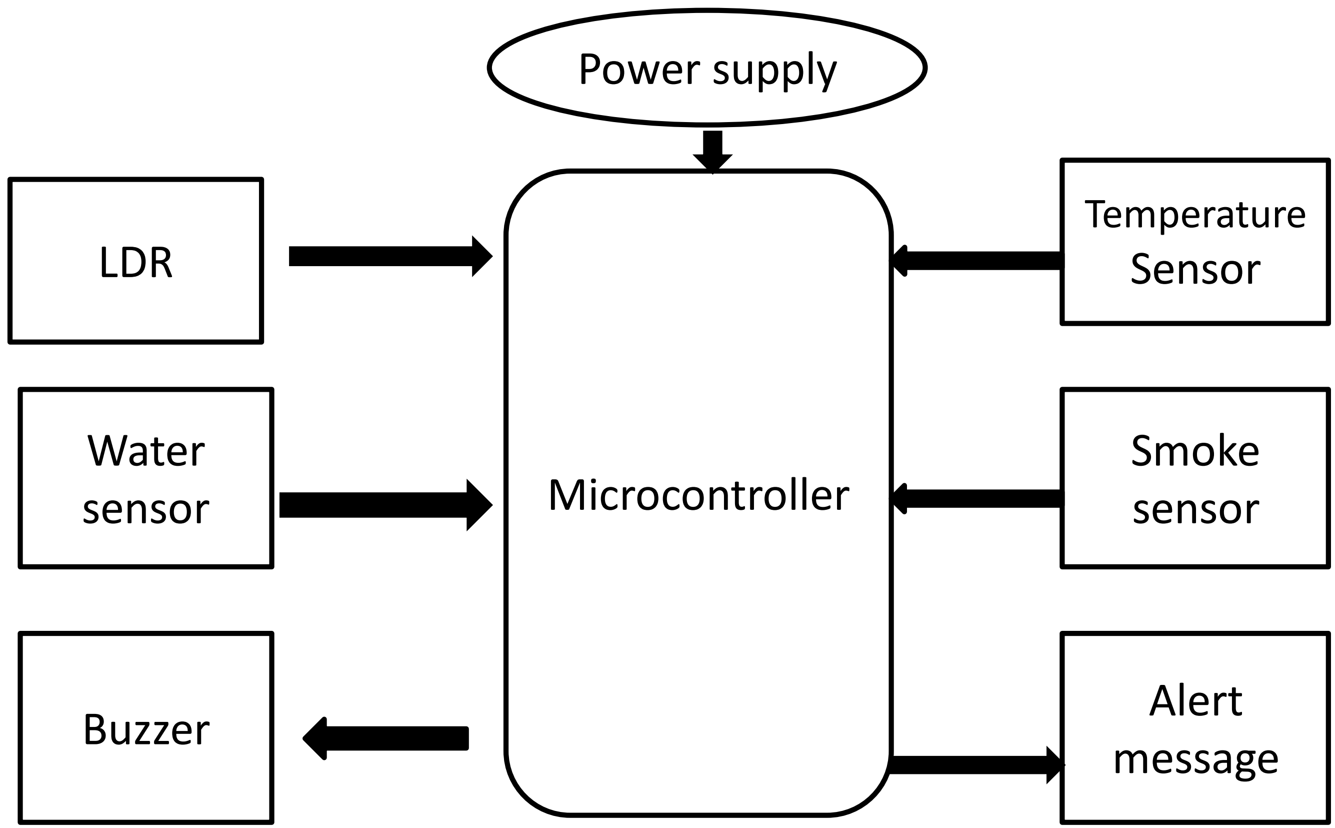
Proposed Methodology



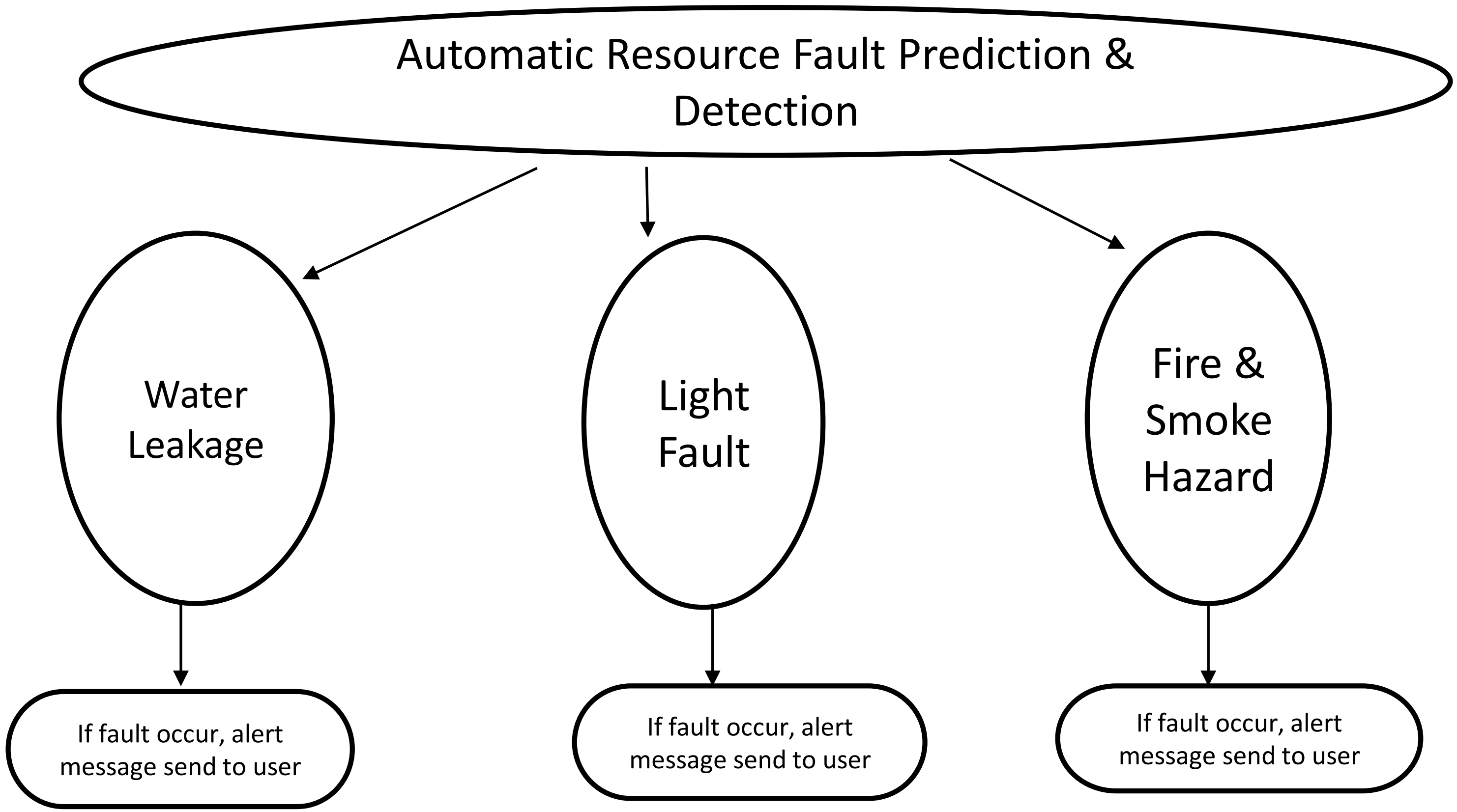
COMPONENTS

- ESP32 Microcontroller
- LDR (Light Dependent Resistor)
- Water Sensor
- MQ-2 Gas Sensor (Smoke Detection)
- Buzzer
- Power Source

BLOCK DIAGRAM



FAULT MANAGEMENT SYSTEM



LITERATURE SURVEY

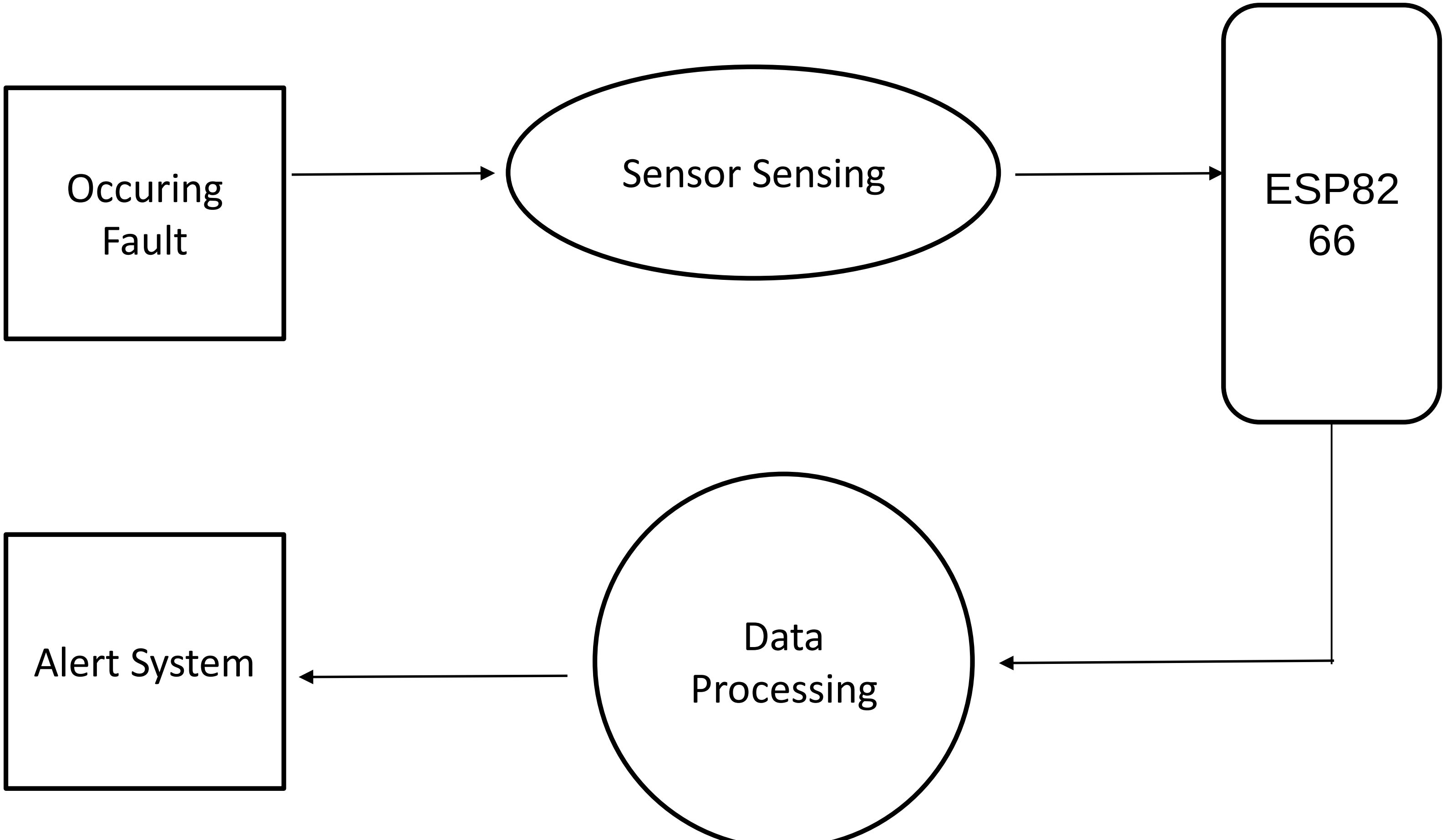
S. NO	AUTHOR	PAPER TITLE	KEY CONTRIBUTIONS	DRAWBACKS	IMPROVEMENT IN OUR PROJECT
1.	M.A.Zamri,M.H.Misran, M.H. F.Rahiman,M. A. M. Ali(2018)	Development of an Early Detection System for Fire Using Wireless Sensor Networks and Arduino	Utilized Wireless sensor networks and Arduino for early detection,ensuring real-time monitoring and improved response times	Limited to fire detecüor only, lacks predictive capabilities and integration with other fault detection systems.	Integrating IoT sensors for fire, water leakage, and lighting fault detection, along with ML-based predictive maintenance
2.	M. Sadeghioon, N. Metje, D. Chapman, C. Anthony(2018)	Water Pipeline Failure Detection Using Distributed Relative Pressure and Temperature Measurements and Anomaly Detection Algorithm	Uses pressure and temperature sensors with anomaly detection algorithms for water pipeline failure detection.	Focuses only on pipeline monitoring, lacks real-time IoT-based alerts.	Our project integrates IoT for real-time alerts and automated fault detection

4.	KB Deve, GP Hancke, BJ Silva(2018)	Design of a Smart Fire Detection System	Fire detection using WSN and GSM with MQ-2 and LM35 sensors to reduce false positives.	Relies only on SMS alerts, no IoT or multi-fault detection	Integrates water leakage, fire/smoke, and light fault detection with IoT-based real-time monitoring.
5.	S. Thenmozhi, K. Sumathi, Anju Asokan, B. Priyanka, R. Maheswar, P. Jayarajan(2019)	IoT Based Smart Water Leak Detection System for a Sustainable Future	An IoT-based system for real-time water leak detection using ATMEGA328 microcontroller, resistance sensors, and flow sensors, integrated with a mobile application.	Focuses only on water leak detection, lacks integration with other fault detection systems.	Our project integrates fire, smoke, water leakage, and electrical fault detection into a single automated system.
6.	K. S. Ng, P. Chen, Y. Tseng(2020)	A Design of Automatic Water Leak Detection Device	Uses sensor-based automation to improve leak detection accuracy and response time.	Limited to pipeline leakage detection, does not incorporate predictive analytics.	Our project enhances fault detection with predictive analytics and machine learning.

7.	J. Kang, Y. J. Park, J. Lee, S. H. Wang, D. S. Eom(2020)	Novel Leakage Detection by Ensemble CNN-SVM and Graph-Based Localization in Water Distribution Systems	Implements machine learning models (CNN-SVM) and graph-based localization for accurate leak detection.	Complex ML model requires high computational resources.	We optimize ML techniques for low-power IoT devices, ensuring real-time predictions.
8.	Maheswaran S, Ridhish R, Vasikaran V, Gomathi R D, Nanthakkumaran S, Sumesh S, Poovizhi S, Sasikala J(2019)	Centralized Monitoring System Street Light Fault Detection and Location Tracking for Smart City	Uses IoT technology and GPS tracking for real-time street light fault detection and location tracking. Improves urban safety and energy efficiency.	Focuses only on street lighting faults, does not include multi-fault detection like fire or water leakage.	Our project expands fault detection to include fire, water leakage, and predictive maintenance using Machine Learning.
9.	Kamoji S, Koshti D, Noronha J, Arulraj E, Clement E(2021)	Deep Learning-based Smart Street Lamps–A Solution to Urban Pollution.	Uses Deep Learning and IoT for automated smart street lighting and environmental monitoring.	Limited to pollution monitoring and street lighting, lacks comprehensive fault detection	Integrates IoT-based fire, water leakage, and predictive maintenance for broader fault management.

ROLE OF SENSOR & DEVICES

- **Light Fault Detection:** Uses **LDR sensors** to spot issues with lighting and ML for Prediction.
- **Water Leakage Detection:** Uses **water sensors** to find leaks quickly.
- **Fire/Smoke Detection:** Uses **smoke sensors(MQ-2)** to detect fire or gas early.
- **Data Processing:** An **ESP32** processes the sensor data.
- **Alert System:** Sends an alert message via the Blynk IoT app to inform the admin when a fault is detected.



Occuring Fault
Sensor Sensing
ESP8266
Data Processing
Alert System

SYSTEM CONFIGURATION

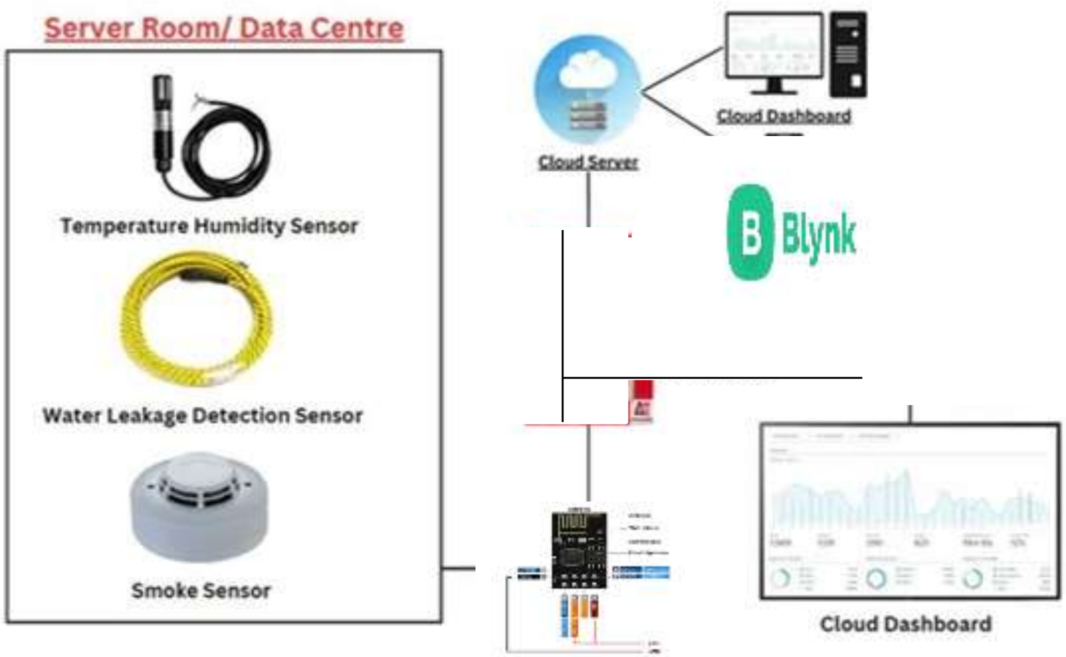
- **Monitoring Environment:** Uses sensors to track lighting, water flow, and smoke levels.
- **Sensor Data Collection:** Gathers data via **LDR**, **water sensors**, and **smoke sensors**.
- **Data Processing:** The collected data is processed using **ESP8266** for real-time fault analysis.
- **Fault Detection Algorithm:** Compares sensor readings with predefined thresholds to identify issues.
- **Memory Storage:** Logs previous fault data for better prediction and analysis.
- **Improved Efficiency:** Ensures resource conservation and enhances safety through early detection.

DATA ACQUISITION

Role of Data Acquisition & Processing:

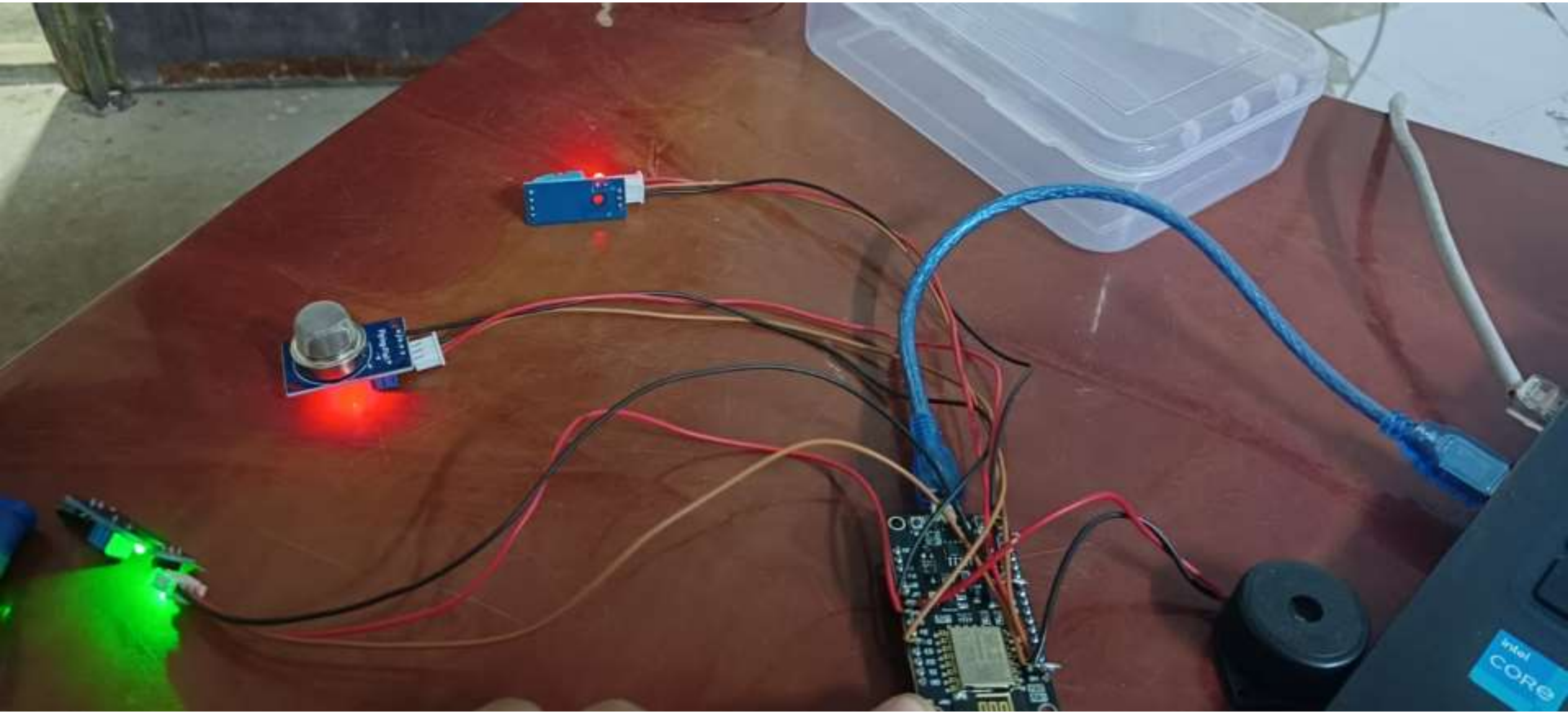
- Collect raw data from multiple sources such as sensors, databases.
- Clean and preprocess the data.
- Transform the data into a structured format suitable for ML model training.

SERVER SET-UP



PHASES OF PROJECT

1. Problem Identification
2. Components Selection and Hardware Design
3. Sensor Interfacing and Data Processing
4. Machine Learning Model Training
5. System Integration
6. Testing and Performance Evaluation
7. User Notification & Alert Mechanism
8. Documentation and Presentation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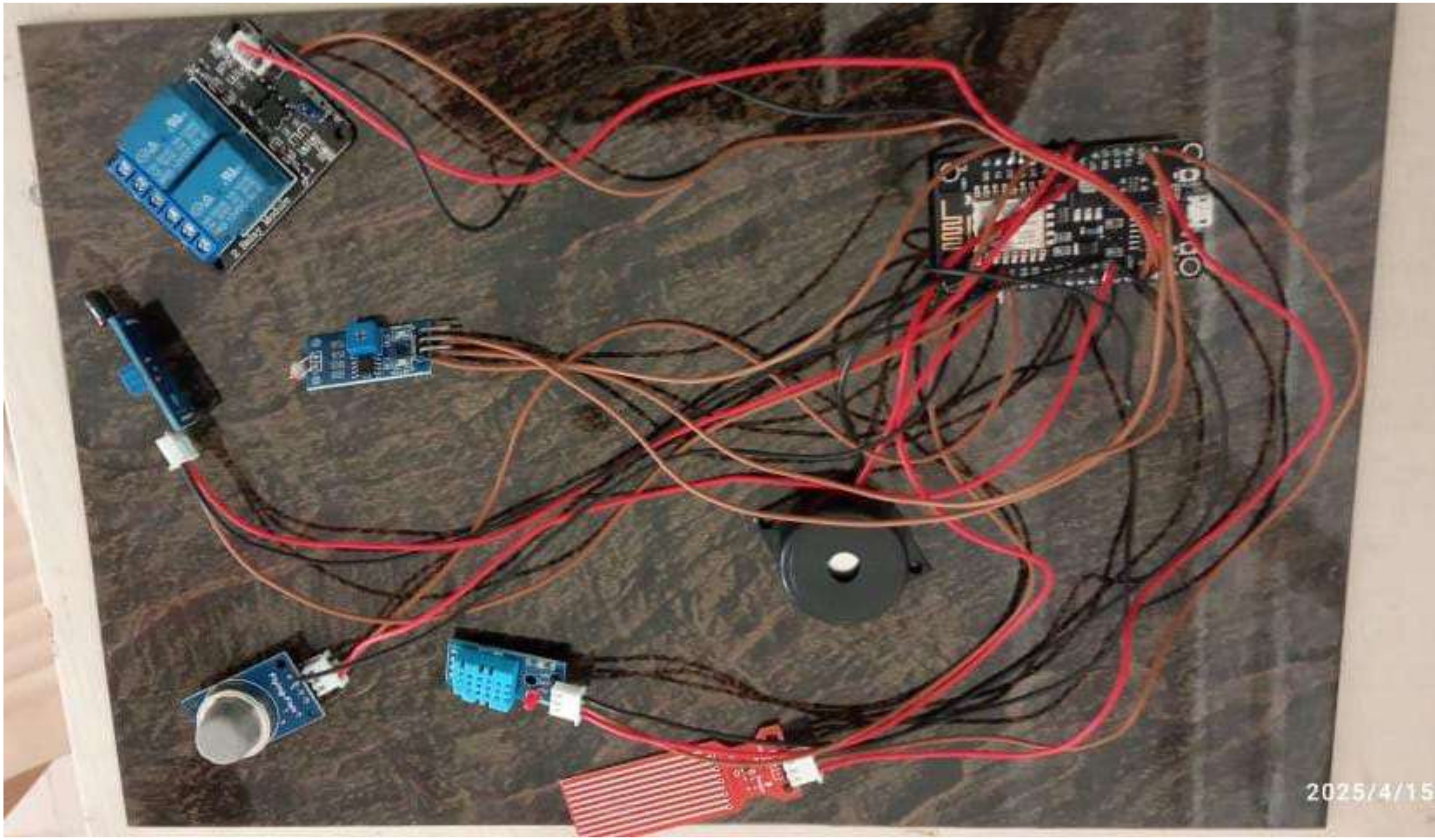
CORE


2 Relay Module
2025/4/15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Auto Resource Fault Detection
temperature
33°C
0
100
fire detection status
No Fire
gas/smoke status
No Smoke
voltage
233V
0
250
current
26A
0
40
water pressure
1%
0
100
LDR
Light Detected

GOALS

- Efficient fault detection & prediction
- Automated real-time alerts
- Cost-effective & power-efficient design
- Reliable ML-based fault classification

CONCLUSION

- The development and implementation of a real-time fault prediction and detection system for lighting, water flow, and fire/smoke monitoring represents a major advancement in resource management and safety. By integrating sensor data with machine learning models, the system ensures high-accuracy fault prediction and enables instant alerts, significantly enhancing safety while reducing manual intervention.
- This low-cost, scalable solution holds strong potential for widespread use across residential and industrial sectors. With future upgrades such as cloud integration, smart mobile alerts, and enhanced sensor capabilities, the system paves the way for a smarter, more efficient approach to resource management and proactive fault detection.

FUTURE ENHANCEMENT

•Implement deep learning models for more accurate fault detection and prediction.

•Enable predictive maintenance to anticipate failures and reduce downtime.

•Extend the system with sensors like air quality, temperature, and GPS.

•Add voice-control features for hands-free system interaction and alerts.

•Integrate automatic communication with emergency services for safety.

•Optimize energy efficiency through intelligent resource management.

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Thank You!