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AI BASED FAULT DETECTION AND PREDICTIVE MAINTENANCE SYSTEM

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ABSTRACT :

The AI-Based Automatic Fault Detection and Predictive Maintenance System is an intelligent software application developed to identify faults in computer laboratory equipment and support predictive maintenance. In conventional maintenance systems, faults are often reported manually by faculty members or technicians, making it difficult to identify problems quickly and maintain equipment efficiently.

The proposed system uses Artificial Intelligence (AI) and machine learning techniques to analyze equipment conditions, detect possible faults, classify fault types and support maintenance decisions. A centralized web dashboard enables faculty members to report issues, technicians to manage and resolve faults, and administrators to monitor equipment status and maintenance activities. The system also provides mobile notifications to alert technicians about detected faults and maintenance requirements.

The system aims to reduce equipment downtime, improve fault detection, simplify maintenance management and support efficient utilization of laboratory resources.

INTRODUCTION:

Computer laboratories contain various types of equipment, including computers, monitors, keyboards, networking devices and other electronic components. The proper functioning of this equipment is essential for conducting practical sessions and academic activities.

Traditional maintenance methods depend mainly on manual inspection and user-reported complaints. These methods may delay fault identification, increase equipment downtime and make it difficult to maintain accurate maintenance records. Unexpected equipment failures can also interrupt laboratory activities and increase repair costs.

The proposed AI-Based Automatic Fault Detection and Predictive Maintenance System addresses these challenges by combining artificial intelligence with a centralized equipment and maintenance management platform. The system enables users to report equipment problems, identifies potential faults using AI-based analysis, assigns maintenance tasks to technicians and tracks the resolution process.

The application provides role-based access for administrators, technicians and faculty members. It also supports mobile notifications, equipment status monitoring, fault history and maintenance reports. The system aims to improve maintenance efficiency and reduce the impact of unexpected equipment failures.

OBJECTIVE:

- To develop an AI-based system for automatic fault detection in computer laboratory equipment.
- To identify and classify equipment faults using AI and machine learning techniques.
- To support predictive maintenance by analyzing equipment conditions and historical fault records.
- To provide a centralized platform for equipment monitoring and maintenance management.
- To notify technicians about detected faults and pending maintenance activities.
- To reduce equipment downtime and improve laboratory maintenance efficiency.

 To maintain fault records, maintenance history and equipment status reports.

LITERATURE SURVEY:

1. Jardine, Lin and Banjevic (2006) studied machinery diagnostics and prognostics using condition-based maintenance. Their research explains how equipment condition information can be used to identify developing faults and support maintenance decisions.
2. Susto et al. (2015) investigated machine learning techniques for predictive maintenance using multiple classifiers. Their work demonstrates how classification algorithms can help predict equipment failures and improve maintenance planning.
3. Lee et al. (2014) presented a framework for smart manufacturing using cyber-physical systems and big data analytics. Their research highlights the importance of intelligent monitoring and data-driven decision-making in industrial equipment maintenance.
4. Lei et al. (2018) reviewed machinery health prognostics and predictive maintenance techniques. Their work discusses fault diagnosis, degradation assessment and remaining useful life prediction for machinery.
5. Carvalho et al. (2019) reviewed machine learning approaches for predictive maintenance. Their research compares different learning methods and discusses their applications in equipment failure prediction and maintenance planning.

METHODOLOGY:

1. **Equipment Registration and Data Collection:** Equipment details, including equipment ID, type, location, condition and maintenance history, are stored in the system. Fault information is collected through user reports and available equipment-condition data.
2. **AI-Based Fault Detection:** The AI processing component analyzes the collected information to identify abnormal conditions and possible equipment faults. Depending on the available data, machine learning models or rule-based analysis can be used to classify faults.
3. **Fault Classification and Prioritization:** Detected or reported faults are categorized according to their type, severity and urgency. This helps technicians prioritize equipment requiring immediate attention.
4. **Predictive Maintenance:** Historical fault records and available condition data are analyzed to identify recurring problems and potential maintenance requirements. This supports preventive action before equipment problems become more serious.
5. **Maintenance Assignment and Notifications:** Faults are made available to technicians for inspection and repair. Mobile notifications alert technicians about detected faults, new assignments and pending maintenance activities.
6. **Monitoring and Reporting**: Administrators can monitor equipment status, reported faults, technician activities, maintenance progress and historical records through the dashboard.
7. **Data Management:** The application uses a web-based frontend, backend services and a database to manage equipment details, user accounts, fault reports and maintenance records. AI processing is integrated with the application to support fault analysis.

EXISTING SYSTEM:

1. **Manual Fault Reporting:**

   Equipment problems are commonly reported through verbal communication or manual records.
2. **Delayed Fault Identification:**

   Faults may remain undetected until a user experiences a problem or a technician performs an inspection.
3. **Reactive Maintenance:**

   Repairs are generally performed after equipment failure rather than identifying potential problems in advance.
4. **Lack of Predictive Analysis:**

   Traditional systems may not analyze historical fault information to identify recurring failures or predict maintenance requirements.
5. **Limited Maintenance Tracking:**

   Maintaining equipment status, repair history and technician activities manually can be difficult.
6. **Unexpected Equipment Downtime:**

   Delays in fault identification and repair can interrupt laboratory activities and reduce equipment availability.

PROPOSED SYSTEM:

1. **AI-Based Fault Detection:**

   Uses AI-based analysis to identify and classify possible equipment faults.
2. **Centralized Equipment Management:**

   Maintains equipment information, current status and maintenance history in one application.
3. **Predictive Maintenance Module:**

   Analyzes available historical and condition data to identify potential maintenance requirements.

4. **Fault Management System:**
   Enables fault reporting, prioritization, assignment and resolution tracking.
5. **Mobile Notification System:**
   Sends notifications to technicians regarding detected faults, assigned tasks and maintenance updates.
6. **Monitoring Dashboard:**
   Displays equipment condition, fault status, maintenance progress and relevant reports.
7. **Role-Based Access Control:**
   Provides appropriate access to administrators, technicians and faculty members.

SYSTEM REQUIREMENTS:

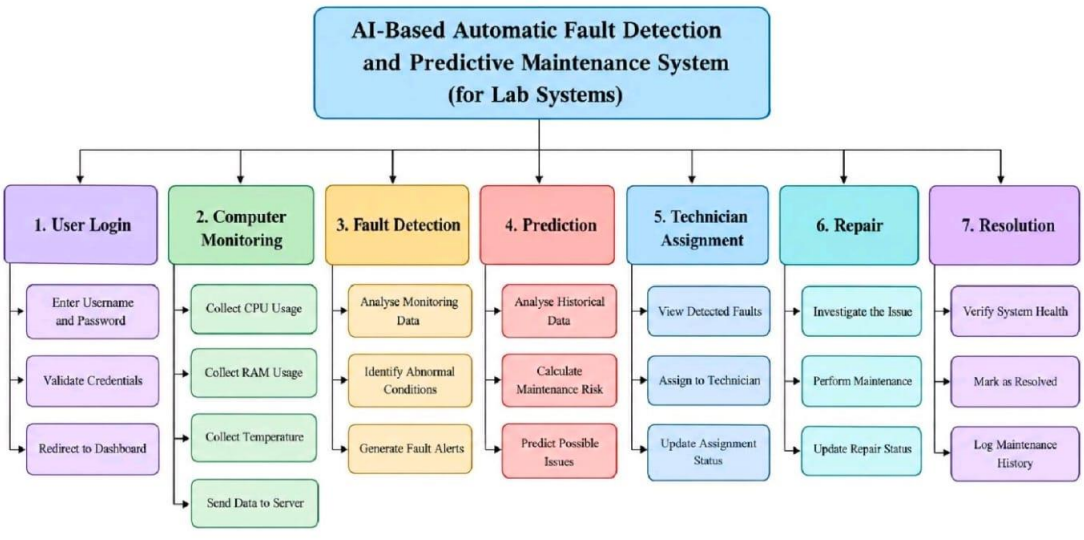
Hardware Requirements:

- **Processor:** Intel Core i3 or higher, or equivalent.
- **RAM:** Minimum 4 GB; 8 GB recommended.
- **Storage:** 256 GB or higher.
- **Display:** Standard HD display or higher.
- **Network:** Stable internet or local network connection for application access and notifications.

Software Requirements:

- **Operating System**: Windows 10/11, Linux or macOS.
- **Frontend**: React.js, Vite, HTML, CSS and Bootstrap.
- **Backend**: Node.js and Express.js.
- **AI Processing**: Python with suitable AI and machine learning libraries.
- **Database**: A suitable database for equipment records, fault reports and maintenance history.
- **Notifications**: A notification service compatible with the implemented mobile notification feature.
- **Browser**: Google Chrome, Mozilla Firefox or Microsoft Edg**e.**

PROCESSING:

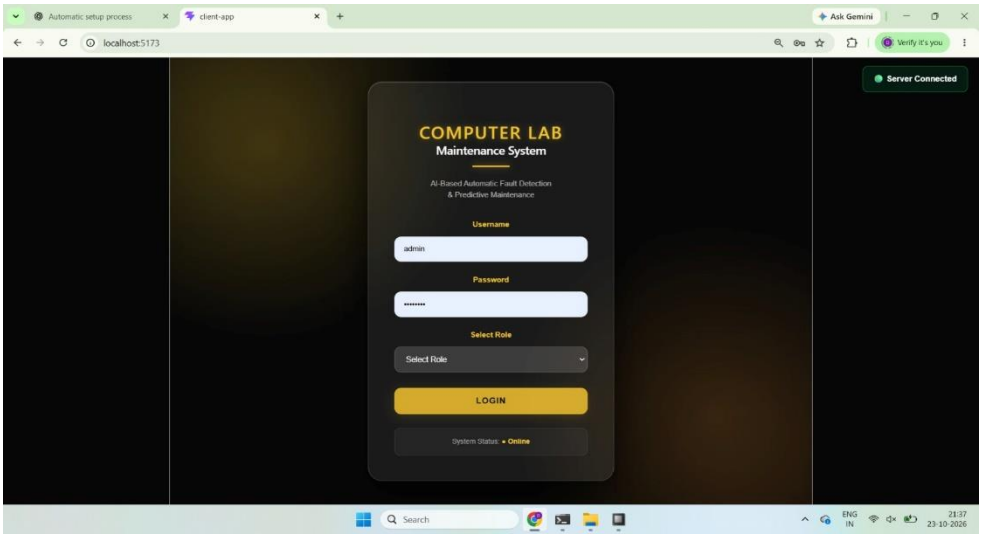


MODULES:

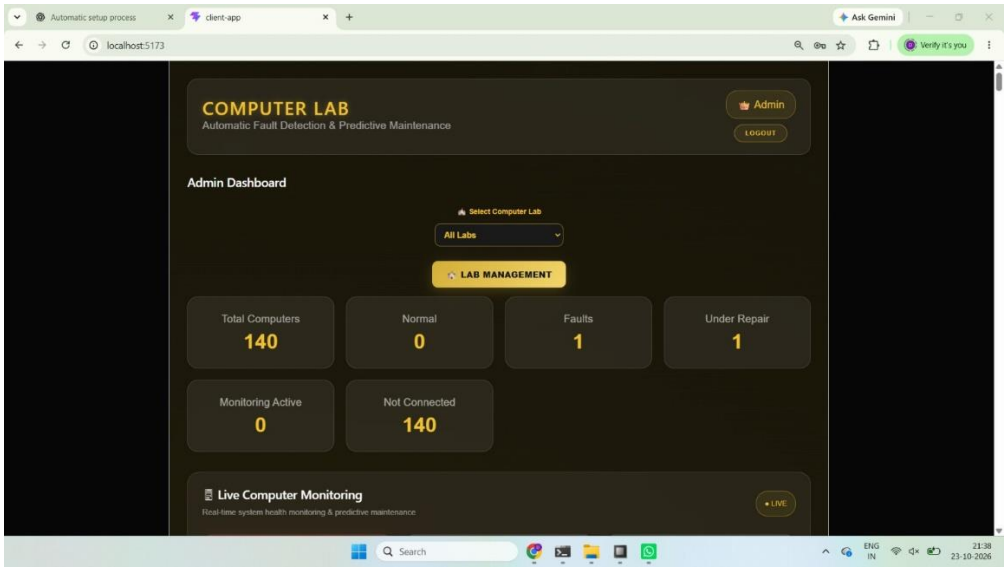
1. Equipment Management: Registers equipment and maintains equipment details, location, condition and availability.
2. Fault Reporting: Enables faculty members and authorized users to report equipment problems.
3. AI-Based Fault Detection: Analyzes available equipment data and fault information to detect and classify possible faults.

4. Predictive Maintenance: Uses historical fault records and available condition data to identify potential maintenance needs.
5. Fault Assignment and Tracking: Assigns faults to technicians and tracks their progress from reporting to resolution.
6. Notification Management: Sends mobile notifications to technicians about detected faults, new assignments and maintenance updates.
7. Dashboard and Reporting: Displays equipment status, fault statistics, maintenance activities and historical reports.
8. User Management: Provides role-based access for administrators, technicians and faculty members.

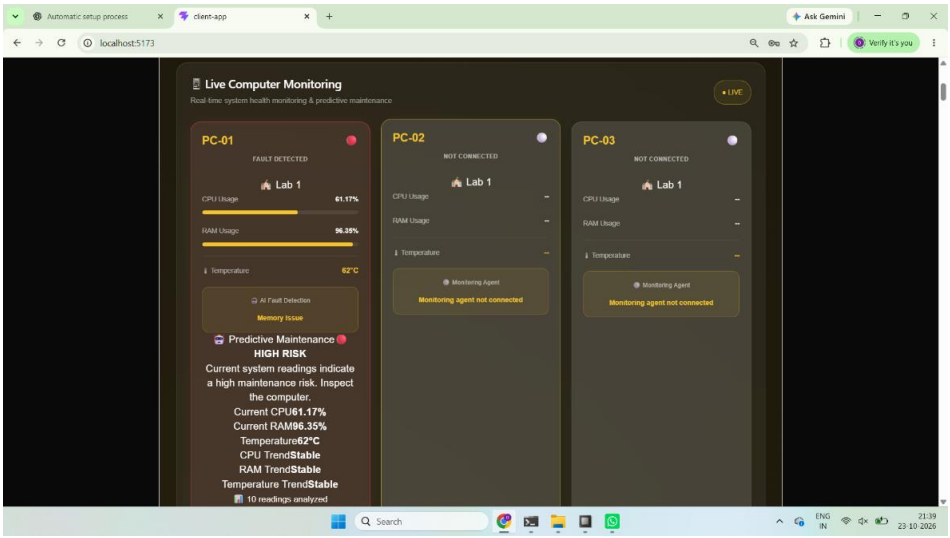
Login Page:



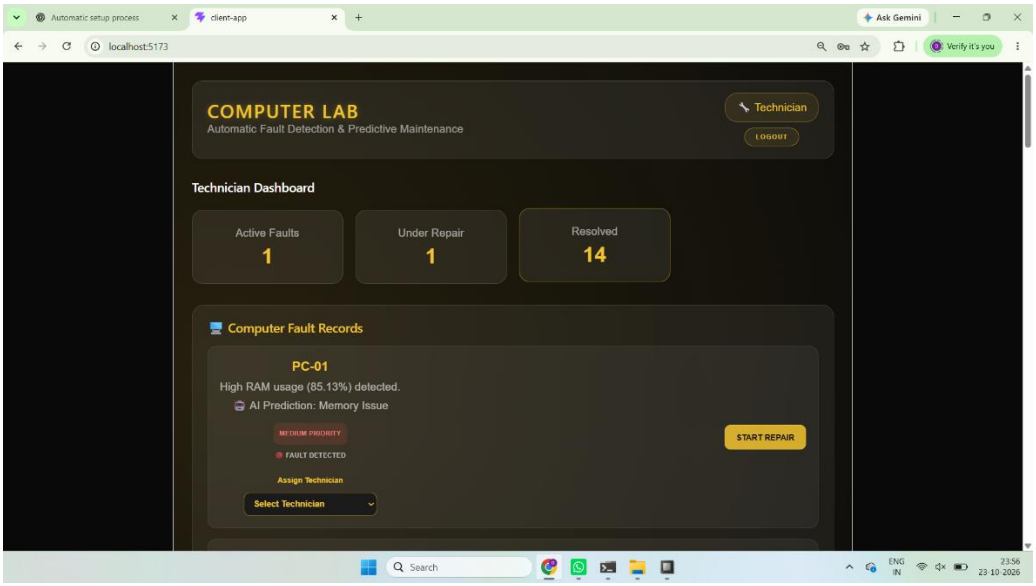
Admin Dashboard:



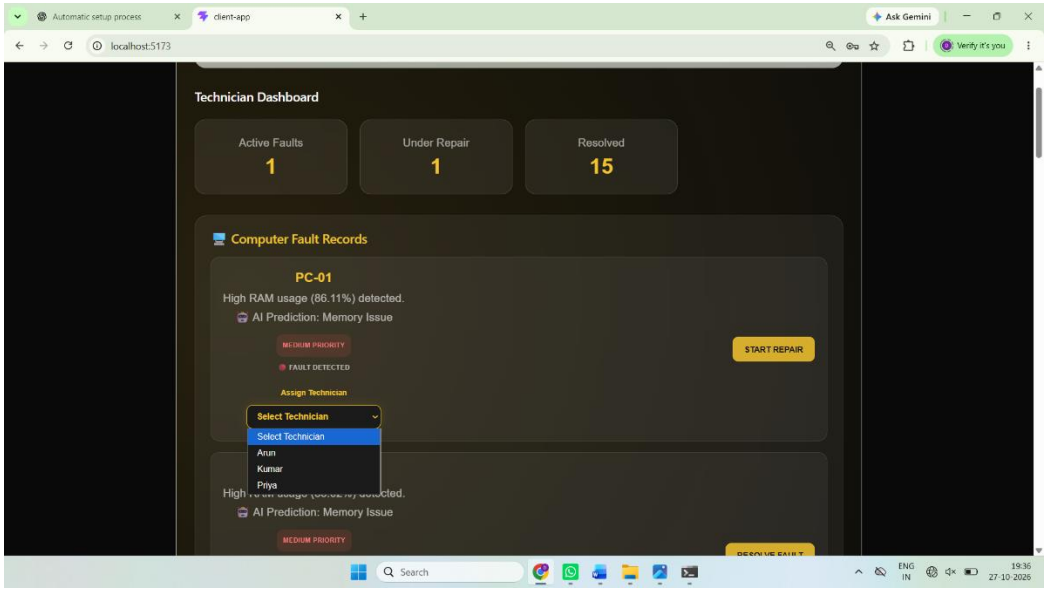
Live Computer Monitoring:



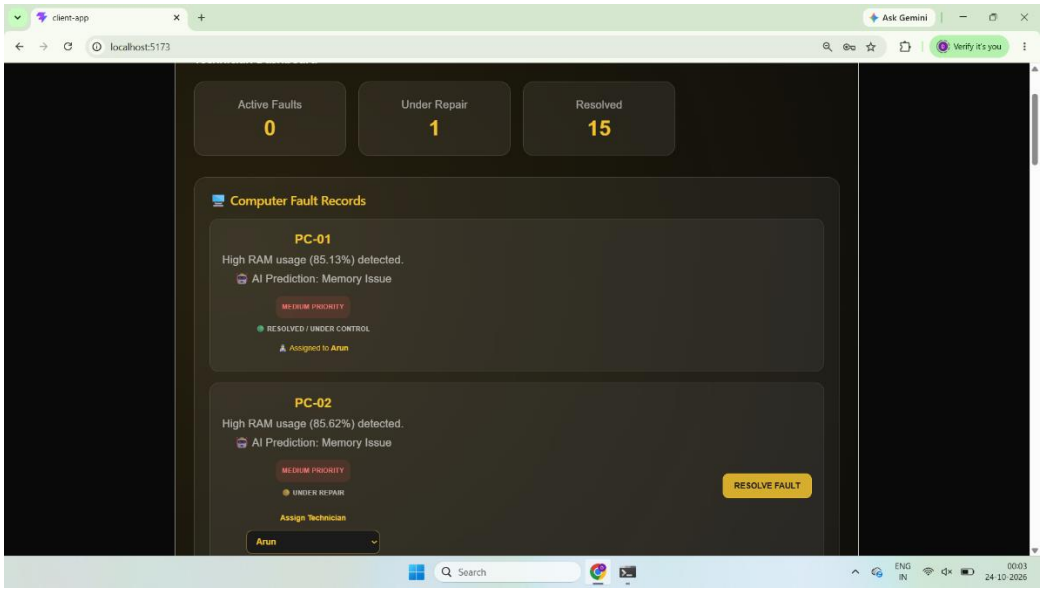
Technician Dashboard:



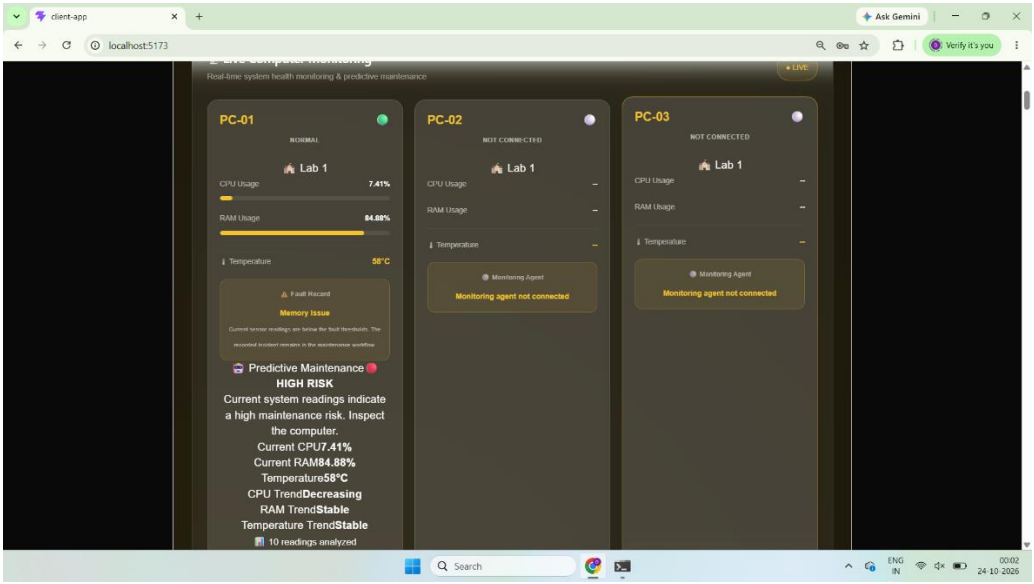
System Under Repair in Technician Page:



Resolved in Technician Page:



Normal Computer Status After Resolution:



CONCLUSION:

The AI-Based Automatic Fault Detection and Predictive Maintenance System provides an intelligent approach to managing equipment faults and maintenance activities in computer laboratories. By combining AI-based fault analysis, equipment management, predictive maintenance and mobile notifications, the system addresses several limitations of traditional manual maintenance methods.

The centralized dashboard enables administrators to monitor equipment conditions and maintenance progress, while faculty members can report problems and technicians can respond to assigned faults. Historical fault information can help identify recurring problems and support more effective maintenance planning.

The system aims to reduce equipment downtime, improve fault management and increase the efficiency of laboratory maintenance. Further improvements in AI models, equipment-condition monitoring and predictive analytics can enhance fault detection accuracy and support more reliable maintenance decisions.

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