
IBM AICTE PROJECT

MACHINE FAULT DIAGNOSIS AGENT USING IBM WATSONX.AI

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OUTLINE

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PROBLEM STATEMENT

Traditional machine fault diagnosis often depends on manual checks and rule-based systems, which can be quite tedious and error-prone. As machines become more complex, there's an increasing demand for smart, automated solutions that can sift through machine data and recommend appropriate maintenance or safety measures based on signs like unusual vibrations, temperature spikes, or strange noises.

PROPOSED SOLUTION

- Harness the power of IBM watsonx.ai to create a smart agent that engages with users, pinpointing potential faults and recommending maintenance steps for machines.
- This agent utilizes advanced language models along with tailored tools for efficient search and data retrieval.
- It effortlessly integrates with user inquiries and taps into external data sources.

SYSTEM APPROACH

- Programming Language:
 - Python 3.11
- Libraries:
 - IBM watsonx.ai (ibm_watsonx_ai, langchain_ibm)
 - LangGraph, LangChain Core
 - Requests, JSON, OS, getpass
- API Usage:
 - IBM Cloud watsonx.ai Foundation Models API

ALGORITHM & DEPLOYMENT

- **Credential Management:**

- Discover how to secure your API authentication with IBM Cloud API keys.

- **Model:**

- Meta-Llama-3-70B Instruct, featuring adjustable inference parameters.

- **Agent Creation:**

- `create_react_agent` is designed for reasoning and taking action.
- The toolbox features search capabilities, web crawling, and access to resources like Wikipedia and DuckDuckGo.

- **Deployment:**

- Hosted through the IBM watsonx.ai Python SDK; executed within a specific project or space context.


RESULT

- We successfully got the agent up and running to tackle user questions about machine faults.
- For instance, it can provide diagnosis suggestions for unusual CNC machine vibrations or issues like overheating in hydraulic pumps.
- The agent takes in user input, smartly picks the right tools, and delivers responses in a clear markdown or structured format.

RESULTS

Agent preview

Why is my CNC machine vibrating too much?

 watsonx Agent 08:23 PM

Based on the search results, there are several possible causes for excessive vibration in a CNC machine. These include:

1. Chatter and vibration: Excessive vibration in the CNC machine tools or cutters can lead to uneven surfaces.
2. Imbalanced tooling: Worn bearings or spindle issues can cause vibration.
3. Mechanical slop: Excess mechanical slop in the Y-axis can cause the servo to be continually hunting back and forth for position.
4. Pressure differences: Too little, too much, or too large differences in pressure can cause vibration.
5. Inadequate, excessive, or uneven clamping force: This can cause vibration in the CNC machine.
6. CNC chatter: Self-exciting vibration that can be traced to the cutting tool or the workpiece.

To reduce vibration in CNC machining, it is recommended to:

1. Check and adjust the tooling and cutters to ensure they are properly balanced and aligned.
2. Inspect and maintain the spindle and bearings

► How did I get this answer?

Type something...



Agent preview

What could cause overheating in a hydraulic pump?

 watsonx Agent 08:28 PM

The causes of overheating in hydraulic pumps include:

1. Contaminated hydraulic fluid
2. Thickened or oxidized hydraulic fluid
3. Blocked fluid filters, pipes, or other components
4. Wear and tear on system components
5. Faulty heat exchangers or cooling systems
6. Low fluid levels
7. Inadequate or excessive clamping force

To solve overheating problems in hydraulic systems, it is recommended to:

1. Check and maintain the hydraulic fluid and system components
2. Ensure proper fluid levels and flow rates
3. Inspect and replace worn or damaged components
4. Adjust or replace faulty heat exchangers or cooling systems
5. Monitor system pressure and temperature

It is also important to note that overheating can lead to serious problems, including system failure, damage to components, and safety risks. Therefore, it is crucial to address overheating issues promptly and take preventive measures to avoid them in the future.

CONCLUSION

- The Machine Fault Diagnosis Agent showcases how cutting-edge language models and tool integration can deliver practical insights for industrial equipment.
- Its adaptable architecture makes it easy to expand by adding more diagnostic tools or integrating additional data.
- It also suggests maintenance steps, safety precautions, and provides references for further troubleshooting.

FUTURE SCOPE

- Integrate IoT machine data to provide real-time diagnostics based on sensor readings.
- Broaden the knowledge base to include a wider variety of machine types and fault conditions.
- Utilize historical maintenance data to offer predictive maintenance suggestions.
- Implement voice-activated interfaces for a hands-free experience.

REFERENCES

- Discover the IBM watsonx.ai documentation and API references, along with the LangChain and LangGraph libraries. Dive into research focused on using AI for machine fault diagnosis and predictive maintenance.

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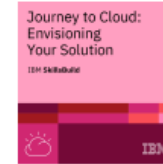
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