

CAPSTONE PROJECT

LabGo

Presented By:

1. Namita D A-BMS College of Engineering-Computer Science

OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

Problem Statement 11: AI Lab Manual and Experiment Generator

Educators and students often face significant challenges in preparing, accessing, and standardizing laboratory manuals and experiments across various educational institutions. The manual creation of lab guides is time-consuming, error-prone, and frequently lacks alignment with updated curriculum standards, safety protocols, and available infrastructure. Additionally, the absence of customizable experiment plans and automated evaluation rubrics makes it difficult to adapt lab experiences to different classroom environments and learning needs.

There is a pressing need for a system that can dynamically generate accurate, curriculum-aligned, and equipment-sensitive lab manuals, complete with procedural instructions, safety guidelines, and grading rubrics. The solution must be scalable, adaptable to multiple subjects and education boards, and capable of retrieving and synthesizing relevant data from trusted academic sources.

PROPOSED SOLUTION

- Created an Agentic AI which generates lab manual and experiments.
- Data Collection:
 - Gathered multiple experiments with all details for grade 12 for chemistry, physics and biology.
- Data Preprocessing:
 - Cleaned and standardized the extracted data for consistency.
 - Removed duplicates, filled in missing values, and aligned formatting across subjects.
 - Organized data into sections with a uniform template for all experiments.
- Agentic AI logic:
 - Used LangGraph framework and ReAct architecture.
 - Natural Language is processed through a vector database called lab_experiments
- Deployment:
 - Develop a user-friendly interface or application that provides real-time solutions for lab-experiments and its alternatives.
 - Deploy the solution on a scalable and reliable platform, considering factors like server infrastructure, response time, and user accessibility.
- Evaluation:
 - Accuracy of experiment data
 - Adhered to NCERT Guidelines

SYSTEM APPROACH

System requirements

Processor: Dual core(i3 or above)

RAM: 4GB minimum

Storage: SSD with minimum 128GB free space

Network adapter: Wi-fi or Ethernet with stable connectivity

Operating System: Windows/macOS/Linux

Web Browsers: Google Chrome/Microsoft Edge/Mozilla Firefox

Library required to build the model

IBM Cloud: watsonx service

Agentic AI lab(beta version)

Framework: LangGraph

Architecture: reAct

Added tools: Google search, DuckDuckGo search, Wikipedia, Webcrawler

Document Search: labexperiments Word Document (consists of defined experiments by Namita)

ALGORITHM & DEPLOYMENT

■ Algorithm Selection:

- The core architecture utilizes an **Agentic Workflow Model** implemented via the **LangGraph framework**, a powerful system for building dynamic, branching workflows with memory and tool usage capabilities. LangGraph enables stateful interactions between language models and tools like retrievers, databases, and formatters. This architecture suits the task well because the generation of lab manuals involves multiple stages: query interpretation, curriculum data retrieval, formatting, safety and rubric generation, and final compilation—all of which benefit from modular, traceable steps and memory.

■ Data Input:

- Vector data: labExperiments Word document
- Course code or Subject
- Preferred topic
- Preferred format (PDF/Markdown)
- Equipment availability (optional constraint)

■ Prediction Process:

- Uses RAG (Retrieval-Augmented Generation) to fetch relevant experiment procedures, safety guidelines, and rubrics from NCERT and other academic repositories

RESULT

Test Case 1: Providing subject code and preferred topic

Test result: Matches the experiment provided in our input document along with rubrics.

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N

You 12:09 AM

hello

watsonx Agent 12:09 AM

Hello! I am your lab manual and experiment generator.I would love to help ease your practical lab process.Please provide me with your subject code,any preffered apparaturs or topic.

N

You 12:09 AM

043,paper chromatography

watsonx Agent 12:09 AM

Sure! Here is a lab manual and experiment generator for Chemistry (043) with a focus on Paper Chromatography:

Type something...

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watsonx Agent 12:09 AM
Sure! Here is a lab manual and experiment generator for Chemistry (043) with a focus on Paper Chromatography:

Experiment: Paper Chromatography

Objective: To separate and identify the components of a mixture using paper chromatography.

Materials:

- Paper chromatography paper
- Scissors
- Pencil
- Ruler
- Calculator
- Stopwatch
- Beaker
- Water
- Food coloring (red, blue, and yellow)
- Coffee filter paper

Type something...

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Procedure:

1. Cut a piece of paper chromatography paper into a rectangular shape, approximately 10 cm x 15 cm.
2. Draw a pencil line along the center of the paper, about 1 cm from the top edge.
3. Place a small drop of each food coloring (red, blue, and yellow) onto the pencil line, about 1 cm apart.
4. Fold the paper in half along the center line, so that the colored dots are facing each other.
5. Place the folded paper into a beaker, making sure that the colored dots are above the water level.
6. Add water to the beaker, making sure that the paper is fully saturated.
7. Cover the beaker with a coffee filter paper, securing it with a rubber band.
8. Place the beaker in a warm water bath, making sure that the water level is below the bottom of the beaker.
9. Allow the paper to develop for 30-40 minutes, or until the colors have separated and moved up the paper.
10. Remove the paper from the beaker and allow it to dry.
11. Measure the distance each color has traveled from the starting line.
12. Calculate the Rf value for each color using the formula: $Rf = (\text{distance traveled by color}) / (\text{distance traveled by solvent})$.

Questions:

1. What is the purpose of the pencil line on the paper?
2. Why is it important to fold the paper in half along the center line?
3. What is the role of the coffee filter paper in the experiment?

Type something...



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1. What is the purpose of the pencil line on the paper?
2. Why is it important to fold the paper in half along the center line?
3. What is the role of the coffee filter paper in the experiment?
4. How does the Rf value relate to the separation of the colors?

Rubric (10 marks):

- Accuracy of measurements (2 marks)
- Correct calculation of Rf values (2 marks)
- Clear and concise answers to questions (3 marks)
- Proper use of materials and equipment (2 marks)
- Overall presentation and organization of the experiment (1 mark)

Note: The rubric is just a sample and can be modified according to your specific requirements.

I hope this helps! Let me know if you have any questions or need further clarification.

► How did I get this answer?



Type something...



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Test Case 2: Asking for alternative Apparatus.

Test result: Provided alternative Apparatus.

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You 12:10 AM

I dont have inkstain or foodcolor what to do?

🤖

watsonx Agent 12:10 AM

If you don't have ink or food coloring, there are a few alternatives you can use for the paper chromatography experiment:

1. **Coffee or tea:** You can use a strong coffee or tea solution as a substitute for ink. Simply brew a cup of coffee or tea, and then use the liquid as the "ink" for your experiment.
2. **Fruit juice:** Certain fruit juices, such as grape juice or berry juice, can be used as a substitute for ink. Just be sure to dilute the juice with water, as it may be too concentrated for the experiment.
3. **Turmeric or paprika:** You can use turmeric or paprika powder to create a yellow or orange "ink" solution. Simply mix a small amount of the powder with water to create a solution.
4. **Beetroot juice:** Beetroot juice can be used to create a pink or red "ink" solution.

Keep in mind that these alternatives may not produce the same level of color separation as ink or food coloring, but they can still be used to demonstrate the principles of paper chromatography.

If you're unable to find any of these alternatives, you can also consider using a different experiment that doesn't require ink or food coloring. Let me know if you'd like some suggestions!

Type something...



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Test Case 3: Asking for experiment suggestions with available equipment.

Test result: Provided a detailed documentation of an experiment using the available equipment.

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You 12:11 AM

I want to perform an experiment with these Optical bench, two sharp-edge pins (object and image needles), one convex lens, one concave lens



watsonx Agent 12:11 AM

Sounds like you're looking to perform an experiment with lenses and optical benches!

Here's a classic experiment you can try:

Experiment: Focal Length of a Convex Lens

Objective: To measure the focal length of a convex lens using an optical bench and sharp-edge pins.

Materials:

- Optical bench
- Two sharp-edge pins (object and image needles)
- One convex lens
- One concave lens (not used in this experiment)

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Procedure:

1. Set up the optical bench with the convex lens in the middle.
2. Place the object pin (sharp-edge pin) at a distance of about 20-30 cm from the lens. This will be the object being observed.
3. Place the image pin (sharp-edge pin) at a distance of about 20-30 cm from the lens, on the other side of the lens. This will be the image formed by the lens.
4. Adjust the position of the object pin until you see a clear, inverted image of the object pin on the image pin.
5. Measure the distance between the object pin and the lens (u). This is the object distance.
6. Measure the distance between the image pin and the lens (v). This is the image distance.
7. Calculate the focal length (f) of the convex lens using the lens equation: $1/f = 1/u + 1/v$
8. Repeat steps 4-7 for different object distances (u) and calculate the focal length (f) each time.
9. Plot a graph of focal length (f) against object distance (u) to verify the lens equation.

Questions:

1. What is the purpose of the object pin and image pin in this experiment?
2. How does the convex lens form an image of the object pin?
3. What is the significance of the focal length of a lens?
4. How does the lens equation relate to the object distance, image distance, and focal length?

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- Use a ruler or meter stick to measure the distances accurately.
- Use a lens holder or clamp to secure the lens in place.
- Repeat the experiment with different convex lenses to compare their focal lengths.
- Try using a concave lens instead of a convex lens to observe the difference in image formation.

Rubric (10 marks):

- Accuracy of measurements (2 marks)
- Correct calculation of focal length (2 marks)
- Clear and concise answers to questions (3 marks)
- Proper use of materials and equipment (2 marks)
- Overall presentation and organization of the experiment (1 mark)

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Deployment Link:

https://dataplatform.cloud.ibm.com/ml-runtime/deployments/98d85b6a-c6c3-4bd5-9a38-d789639e7eea/chat?space_id=c5a8351d-42f6-43b0-b2a3-d3c0ea83cf07&context=wx&flush=true

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CONCLUSION

The Agentic AI Lab Manual & Experiment Generator, built using the LangGraph framework with Retrieval-Augmented Generation (RAG), successfully automated the creation of structured, syllabus-aligned lab manuals for Class 12 Physics, Chemistry, and Biology. The system was able to:

- Generate detailed experiment sections (aim, apparatus, procedure, safety standards, and rubrics) accurately.
- Customize content based on syllabus inputs and subject selection.
- Maintain consistency and format readiness across all experiments.
- Reduce manual effort by automating information retrieval, formatting, and evaluation criteria inclusion.

This agentic system proved especially effective for educators seeking standardized, printable, and customizable lab documentation aligned with NCERT and CBSE norm

FUTURE SCOPE

- Multilingual and voice input
- Adaptive and Personalised learning
- Real-time safety compliance monitoring
- Integration with virtual lab and Stimulators

REFERENCES

- Central Board of Secondary Education
<https://cbseacademic.nic.in>
- *Laboratory Manual Physics – Class XII*, NCERT
- *Laboratory Manual Chemistry – Class XII*, NCERT
- *Laboratory Manual Biology – Class XII*, NCERT
Available at: <https://ncert.nic.in/textbook.php>
- Automating with AI Agents IBM Documentation
URL: <https://dataplatform.cloud.ibm.com/docs/content/wsj/analyze-data/fm-agents-overview.html?context=wx&audience=wdp>

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This certificate is presented to

Namita DA

for the completion of

**Lab: Retrieval Augmented Generation with
LangChain**

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT)

Learning hours: 20 mins

RAG Lab completion certificate



THANK YOU