



LLM POWERED CHATBOT FOR PERSONALIZED LEARNING

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Abstract: Personalized learning is important because every student learns at a different speed and has different goals. Many learners face difficulty while studying online due to a lack of guidance, unclear explanations, and no immediate feedback. To solve this problem, this project presents an **LLM Powered Chatbot for Personalized Learning**. The system works as a virtual tutor that interacts with learners through a web application. It allows users to enter a learner profile such as name, knowledge level, learning goal, and learning style. Based on these details, the chatbot generates customized responses that are easier to understand. The system also provides additional learning tools such as quiz generation and learning roadmap creation. Quizzes help learners test their knowledge, and roadmaps provide a structured plan for learning a topic step by step. The proposed system uses a locally hosted LLM (via Ollama) to generate answers, ensuring privacy and reducing dependency on cloud services. The results show that the chatbot improves the learning experience by giving clear explanations, supporting self-assessment, and helping learners follow a structured learning path.

Keywords: Large Language Model (LLM), Personalized Learning, Chatbot, Virtual Tutor, MCQ Generation, Learning Roadmap, Flask, Ollama, Education Technology

I. INTRODUCTION

Education has become more accessible due to online learning platforms, but many students still struggle to learn effectively without proper support. In traditional classrooms, teachers can explain topics in different ways depending on student understanding. However, in online learning environments, learners often depend on static content such as videos or notes, which may not match their learning level or preference. Because of this, students may feel confused and lose interest.

A chatbot-based learning assistant can solve this issue by providing interactive learning through conversations. With the development of **Large Language Models (LLMs)**, chatbots can now understand questions in natural language and provide meaningful answers. This project uses an LLM to build a personalized learning tutor that explains concepts based on student needs. Along with chat, the system includes quizzes and roadmaps to improve the learning process.

PROJECT DESCRIPTION

The **LLM Powered Chatbot for Personalized Learning** is a web-based application that supports learners by providing personalized explanations, quizzes, and topic roadmaps. The learner starts by entering profile information such as:

- Name
- Learning level (Beginner / Intermediate / Advanced)
- Learning goal
- Preferred learning style (short explanation, step-by-step, etc.)

After setting up the profile, the learner can ask questions using the chat module. The chatbot provides responses according to the learner profile, which makes explanations simpler and more targeted. The system also provides:

- **Quiz Generation:** Creates multiple-choice questions for a topic
- **Score Evaluation:** Helps learners know their performance
- **Learning Roadmap:** Gives step-by-step topic learning plan
- **Progress Viewing:** Helps track learning improvement

The backend is developed using **Flask**, and the LLM runs locally using **Ollama**, making the system cost-effective and private.



MOTIVATION

The motivation for this project comes from common problems faced by students during self-learning. Many learners find it difficult to understand concepts when they do not have someone to guide them. Some learners need simple explanations, while others prefer detailed steps. Most traditional learning platforms do not adapt to these needs. This creates a gap between the learning content and learner understanding.

The major motivating factors are:

- Learners require **personalized explanations** based on their level
- Students need **instant doubt clarification** without waiting for teachers
- Quizzes are useful for testing knowledge, but many platforms do not generate them automatically
- Roadmaps help learners follow a structured learning plan
- Local LLM support improves privacy and reduces API cost dependency

This project aims to provide an intelligent tutor that supports learners in a simple and effective way.

II. RELATED WORK

Many studies have been carried out in the area of AI-based learning systems and educational chatbots. Earlier systems mostly used rule-based chatbots, where predefined answers were stored for specific questions. Such systems could only handle limited conversations and failed when users asked new or complex questions.

Later, Natural Language Processing (NLP) improved chatbots by allowing better understanding of user input. Some educational chatbots were developed to assist learners by answering frequently asked questions or providing basic explanations. However, most of these systems still lacked proper personalization because they did not consider learner profile or learning style.

In recent years, the use of **Large Language Models (LLMs)** has shown strong improvement in generating human-like answers and supporting multiple topics. LLM-based tutors can generate explanations, examples, and question sets dynamically. Many modern learning assistants also provide quizzes and summaries. However, most of them depend on cloud services and paid APIs, which may not be suitable for all learners and institutions.

The proposed system differs from many existing solutions by combining:

- learner-profile-based personalization
- interactive chat learning
- quiz generation and evaluation
- roadmap generation
- local LLM execution for privacy and cost reduction

III. METHODOLOGY

The methodology of this project follows a modular approach where each learning feature is implemented as a separate component connected to a common backend system. The complete working process is divided into the following stages:

1. Learner Profile Creation

The user enters profile details such as learning level, goal, and learning style. These values help the system understand how to respond to the learner in an appropriate format.

2. Chat-Based Personalized Learning

When the learner asks a question, the system combines the question with learner profile information and sends it to the local LLM. The LLM generates an explanation based on the provided context.

3. Quiz Generation

When the learner selects a topic for quiz generation, the system prompts the LLM to generate multiple-choice questions. These questions include options and correct answers.

4. Score Evaluation

After the learner answers the quiz, the system checks the answers and calculates the score. The result is displayed immediately to the learner.



5. Roadmap Generation

The learner can request a learning roadmap for a specific topic. The system prompts the LLM to generate a structured step-by-step roadmap, which is shown to the learner.

6. Progress Tracking

Progress tracking stores quiz scores and roadmap completion information so that learners can see improvement over time.

This methodology ensures that the system is interactive, adaptive, and user-friendly.

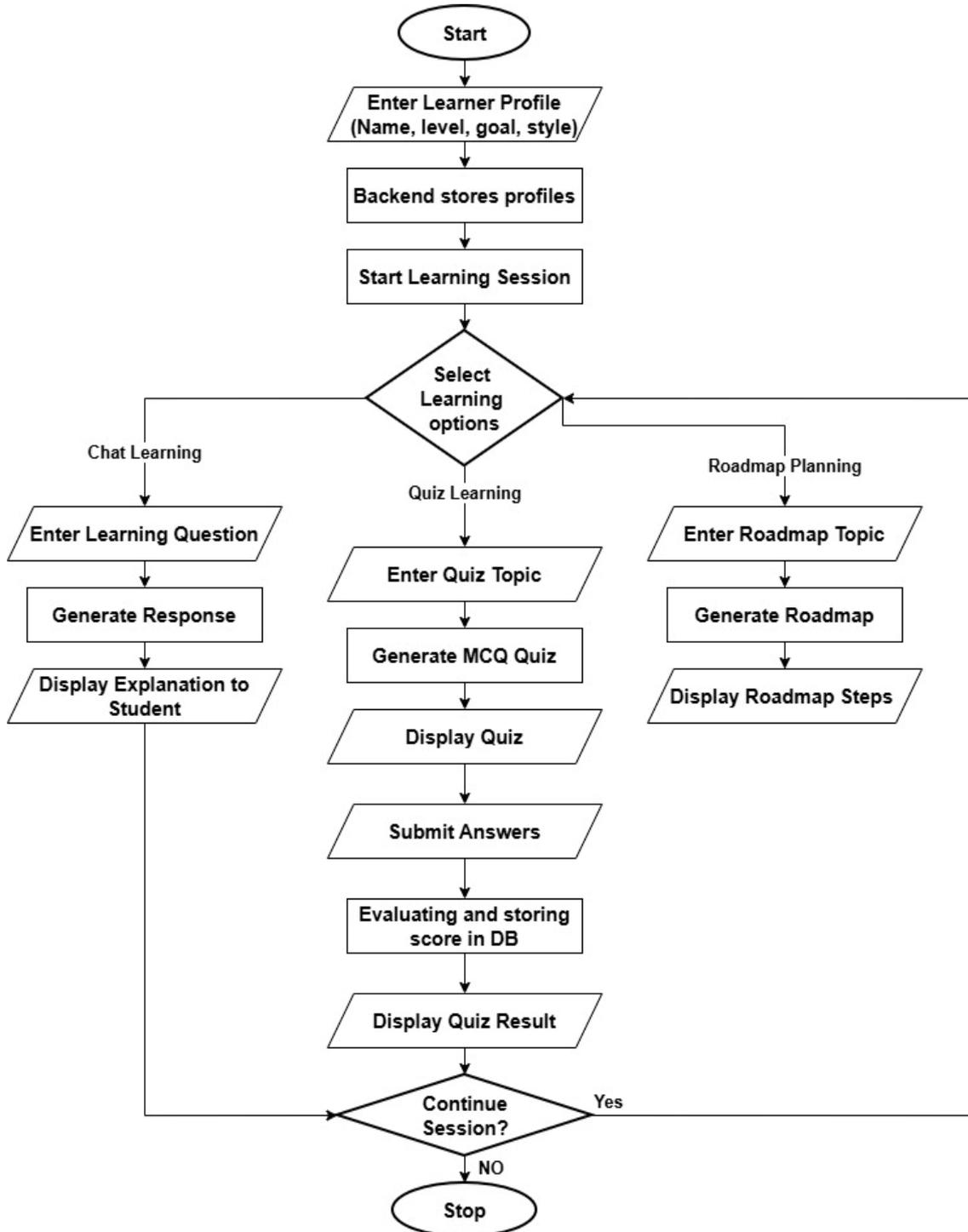


Fig 1: Flowchart



IV. RESULTS AND EVALUATION

The system was tested using multiple learning topics such as Python variables, loops, operating systems, and data structures. The evaluation was mainly based on the following parameters:

1. Response Quality

The chatbot was able to generate meaningful answers and explanations based on the learner's profile. Beginner users received simpler explanations, while intermediate users received slightly more detailed responses.

2. Quiz Generation

The quiz module successfully generated multiple-choice questions for various topics. The generated quizzes were useful for quick self-assessment and revision.

3. Roadmap Generation

The roadmap module produced step-by-step learning plans that helped learners understand the correct order to study a topic. This improved structured learning.

4. System Usability

The web application interface made it easy for learners to use the chatbot, switch between chat, quiz, and roadmap, and view outputs smoothly.

5. Local Execution

Using Ollama for local LLM execution reduced dependency on external API keys and improved privacy.

Overall, the system performed well and achieved the expected learning support features successfully.

Local Personalized Tutor (Ollama)

1. Fill your details on the left and click **Start Tutor**.
2. Use the **Chat** tab to talk to your tutor.
3. Use the **Quiz** tab to generate MCQs and test yourself.
4. Use the **Roadmap / Progress** tab to plan your learning and see stats.

Learner Profile

Name: e.g. Vinay

Level: Beginner Intermediate Advanced

Goal: e.g. Learn Python basics

Learning Style: e.g. Short explanations, examples, slow pace

Start Tutor

Chat Quiz Roadmap / Progress

Tutor Chat

Ask something...
e.g. Explain variables in Python

Send

Fig 2: Home page

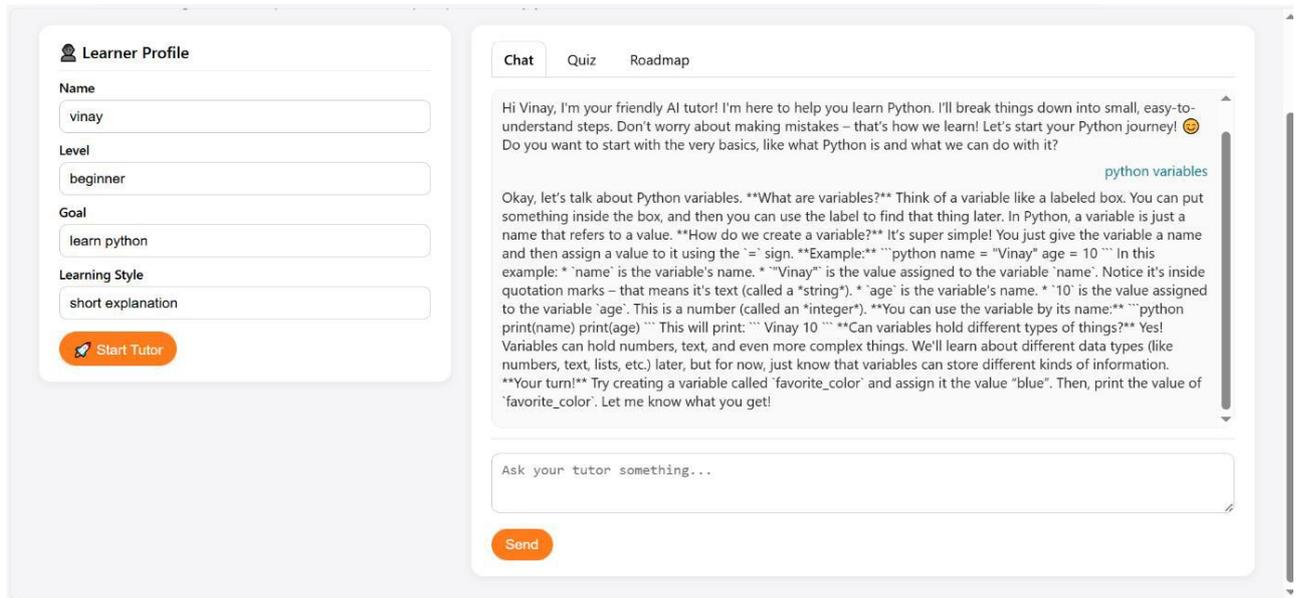


Fig 3: Chat page

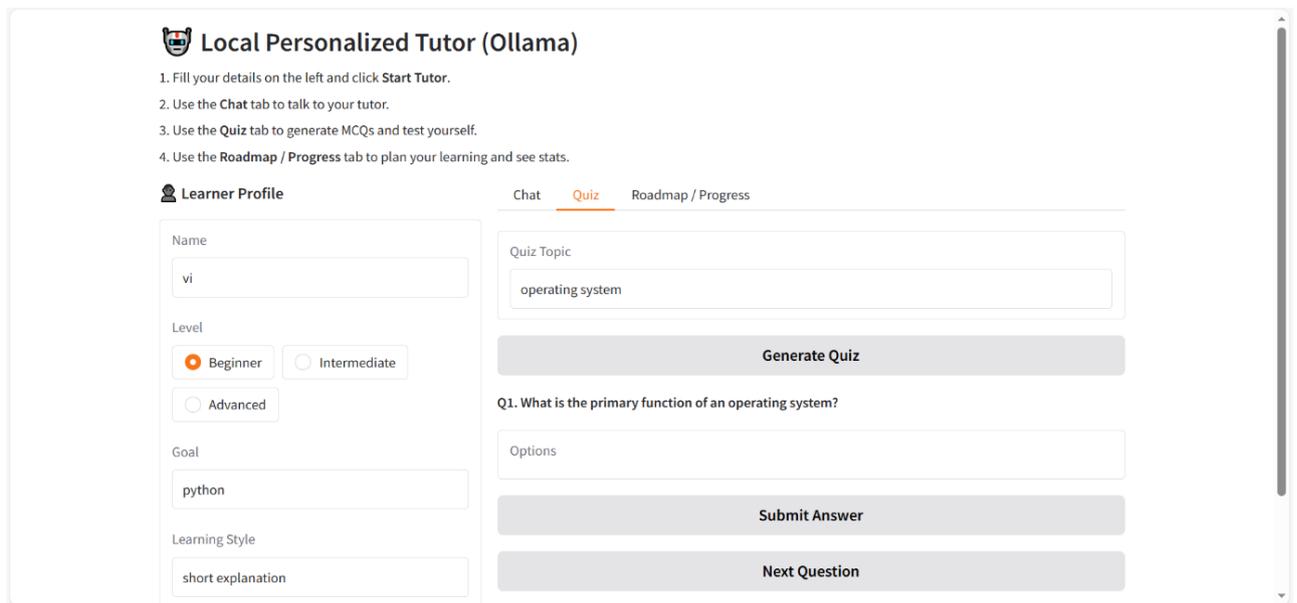


Fig 4: Quiz page

V. DISCUSSION

The proposed system demonstrates that LLM-powered learning assistants can provide strong support for self-learning. Personalized explanation is a major advantage because learners do not always require the same level of detail. Some learners want short explanations, while others need step-by-step guidance. The profile-based approach makes responses more suitable for the learner.



The quiz module increases engagement and helps learners test their knowledge. Roadmap generation supports structured learning, especially for learners who do not know where to start. Local LLM execution helps maintain privacy and reduces cost.

However, there are certain limitations. Since the system depends on the local machine for model execution, performance may vary based on system RAM and processing power. Very large models may not run smoothly on low-memory devices. Also, the quality of responses depends on the model used.

Despite these limitations, the system provides a useful, practical learning solution.

VI. CONCLUSION

This project successfully developed an **LLM Powered Chatbot for Personalized Learning** that acts as a virtual tutor. The system provides learner-level explanations, quiz generation, scoring, and roadmap creation through an interactive web application. By using a learner profile, the chatbot produces responses in a more understandable format. The quiz module supports self-evaluation, while roadmaps help learners plan learning in a structured way. The use of a locally hosted LLM improves privacy and reduces external dependency. Overall, the project proves that LLM-based systems can be effectively used to support personalized education.

VII. FUTURE WORK

Although the system performs well, it can be improved further with additional features. Future enhancements may include:

- Adding a complete database system to store long-term learning history and progress
- Supporting detailed analytics such as topic mastery percentage and weak areas
- Improving quiz evaluation with adaptive difficulty levels (easy, medium, hard)
- Adding multi-language support for learners from different regions
- Integrating speech input and audio-based answers for accessibility
- Deploying the system as a mobile app for easy access on smartphones
- Adding recommendation features to suggest topics based on learner performance

These improvements can make the system more advanced and useful for real-world learning environments.

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