

CampusGPT: A Review of Autonomous Multi-Agent Artificial Intelligence Systems for Smart Campus Automation

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Abstract:

In the past decades, the fast development of AI technology has changed the current educational landscape. The implementation of smart campus solutions aims to automate the entire process of providing various services to students and faculty members within universities or other educational institutions. Recently, many studies have been published about the application of multi-agent systems, machine learning, natural language processing, large language models, and retrieval-augmented generation in different domains, including intelligent student assistance, career counseling, automated task generation, examination paper production, and academic questions solving. This review paper conducts a detailed overview of all available autonomous AI frameworks developed for the purpose of implementing smart campus solutions. In addition, the study analyzes recent publications, compares techniques and architectures, points out possible shortcomings, and provides suggestions for overcoming the identified barriers. Finally, the paper discusses the role of the multi-agent system called CampusGPT, which can be considered a promising solution to address the mentioned problems with existing fragmented systems.

Keywords: Smart Campus, Multi-Agent Systems, Artificial Intelligence, Large Language Models, Retrieval-Augmented Generation

1. Introduction

The incorporation of AI in the education sector has greatly facilitated the conversion of conventional learning centers into smart campuses. A smart campus refers to an intelligent environment that uses sophisticated technology including machine learning, natural language processing, cloud computing, and data analytics to automate educational and administrative processes, optimize operations, and increase the quality of the overall education experience of learners and educators.

Recent trends in the education industry have seen the implementation of intelligent systems in activities ranging from solving queries posed by students, offering customized career counseling, automatic generation of assignments and examination papers, tracking attendance, and analyzing academic performance. In particular, the use of multi-agent systems has proven to be a viable solution because of their modularity, scalability, and ability to undertake specialized tasks through teamwork between autonomous agents.

There have been several studies on the use of AI-powered chatbot, recommendation system, and intelligent retrieval agent to solve problems in various fields of education. The development of large language models and the RAG approach has improved the efficiency and capabilities of such systems in providing more context-aware, in-time, and personalized responses. However, despite these improvements, current applications still tend to be very specific to a particular field and disjointed to address only one task at a time, thus failing to deliver a unified solution.

Such a scenario makes there exist the need for the development of an intelligent architecture that will be able to integrate various services offered by campuses in a single AI-powered platform. In this regard, CampusGPT is seen as a multi-agent AI-based approach that integrates different campus-related services ranging from career guidance and assignment generation to intelligent question-answer services and question paper generation. The main aim of this review paper is to conduct an in-depth analysis of the existing literature on autonomous multi-agent AI platforms for solving campus automation problems.

2. Literature Review

The deployment of artificial intelligence within educational settings has paved the way for the emergence of intelligent smart campuses that are designed to automate various activities in academics and administration. Current research trends have involved using multi-agent systems, machine learning methods, and retrieval-augmented generation frameworks as means of achieving a solution that is scalable and learner-focused.

2.1 Multi-Agent Systems in Smart Campus Environments

Multi-agent systems (MAS) have been shown to be an effective approach to developing distributed intelligent systems in educational domains. Wooldridge [5] proposed the key principles behind autonomous agents and collaborative decision-making which still lie at the core of smart campus designs. Smith et al. [2] provided a survey of current agent-based architectures and their applications in institution management and intelligent automation.

Smart campuses benefit from the use of MAS since it helps to distribute tasks through specialized agents responsible for academic aid, resource management, and student care. The design makes such systems more scalable, robust, and flexible; thus, it is appropriate for large-scale learning contexts. There have been some research efforts directed at creating multi-agent retrieval systems, which are better in terms of context accuracy.

2.2 Retrieval-Augmented Generation and Conversational Academic Support

Conversational AI models have also been considered one of the key components of intelligent campus automation. In recent times, the classic rule-based chatbot has been increasingly superseded by large language model (LLM) approaches coupled with the Retrieval-Augmented Generation (RAG) architecture. Lewis et al. [7] proposed the latter as a technique that allows combining document retrieval and generative approaches to minimize AI-generated errors.

The current surveys on the application of RAG in education suggest that RAG-based conversational AI systems have found wide adoption in areas such as student query management, intelligent tutoring, and assessment feedback systems. For instance, Swacha [10] reviewed 47 papers dedicated to the study of educational RAG chatbots. Moreover, the development of LLM-based assessment systems within higher education is another example of the practical use of such architectures.

2.3 Machine Learning-Based Career Recommendation Systems

Personalized career guidance also falls into the category of research in smart educational systems. A number of machine learning methods, including Random Forest, Support Vector Machines, and Decision Tree, have been applied to resumes, performances, and skill sets for the purpose of career path prediction.

One such method is Breiman's Random Forest classifier [9], which is considered the most commonly utilized ensemble learning approach. Applications of machine learning-based career recommendation system

have been proposed by Kumar & Singh [8] for identification of skills deficit areas and providing a roadmap for learning. Such career recommendation systems can be extremely useful in student-focused smart campus environments.

2.4 Automated Assignment and Question Paper Generation

The field of automated academic content generation has been attracting significant interest due to the emergence of NLP and LLM-powered educational applications. Traditional methods involved rule-based question creation and templates, which had a constrained range of variations.

Hairui and Hua [12] suggested an algorithm for test paper generation based on multiple agents, showing how a system of intelligent components can be applied for the creation of exam papers according to a syllabus. More advanced methods employ transformer models and LLMs for assignment creation and generating questions papers with different levels of complexity. Such trends reveal the evolution from standalone educational applications to integrated intelligent solutions that can automate several academic processes.

3. Comparative Analysis and Research Gap

As is clear from the reviewed literature, there have been remarkable advancements in the area of applying AI to education through automation. Unfortunately, most of the current approaches concentrate on individual processes rather than creating a smart campus system. The following table highlights some key contributions to the area.

Reference	Methodology	Application Area	Strengths	Limitations
Smith et al. [2]	Multi-Agent Systems	Institutional Support	Modular design, distributed tasks	Limited academic integration
Lewis et al. [7]	RAG + LLM	Query Resolution	Context-aware, accurate responses	High computational cost
Kumar et al. [8]	Random Forest / ML	Career Guidance	Personalized recommendation	Dataset dependency
Hairui et al. [12]	Multi-Agent Algorithm	Question Paper Generation	Automated syllabus-based generation	Limited scalability
Swacha [10]	Educational RAG Chatbot	Student Query Support	Real-time academic assistance	Domain-specific implementation
CampusGPT (Proposed)	Autonomous Multi-Agent AI	Integrated Smart Campus	Unified multi-service framework	Under development

Table 1. Comparative Analysis of Existing Smart Campus AI Systems

From this comparative study, it becomes clear that the existing body of research mainly focuses on providing separate intelligent services such as conversational support, career recommendations, or auto-generation of content. Very few researchers have attempted to integrate all of these services within a single intelligent framework. The biggest limitation of the research lies in creating a truly integrated autonomous multi-agent system that would be capable of offering several services simultaneously within a smart campus setting.

The existing systems suffer from several limitations, including limited scalability, lack of data privacy, non-personalized service provision, interoperability issues, and slow reaction time.

It is also worth noting the problem of cloud-based systems that pose a threat to data privacy within institutions. Another important limitation relates to the lack of modularity in the use of intelligent agents for several different academic activities. This highlights the importance of an integrated solution like CampusGPT, whose main goal includes providing several academic services under one intelligent multi-agent system umbrella.

4. Proposed Framework

The proposed solution is referred to as the CampusGPT model, which is based on an artificial intelligence-based multi-agent system that allows for the automation of the process of academic support in the context of a smart campus. This approach relies on the four-level architecture, consisting of several functional modules, which can be illustrated using workflow diagrams. The functional modules include the career guidance agent, the assignment generation agent, the intelligent query resolution agent, and the question paper generation agent.

4.1 Career Guidance Agent

Workflow for the process of career guidance has been shown in Fig-1, which begins with the extraction of the student's resume in pdf form along with questionnaires filled by the users. The document parses a variety of documents in order to extract critical attributes such as skills, education and performance. These extracted attributes are combined through a feature construction module to develop a complete profile of the student. Next, the text-based profile of the students is encoded numerically using TF-IDF Vectorizer alongside a contextual N-Gram encoding mechanism. Once the numeric features are extracted, these are input to the supervised ensemble learning model in order to find the best possible career options among pre-defined sets of careers. The career option selected for the students is matched against a skill taxonomy repository in order to discover any potential skill gaps, which are further used to identify relevant learning resources for the student.

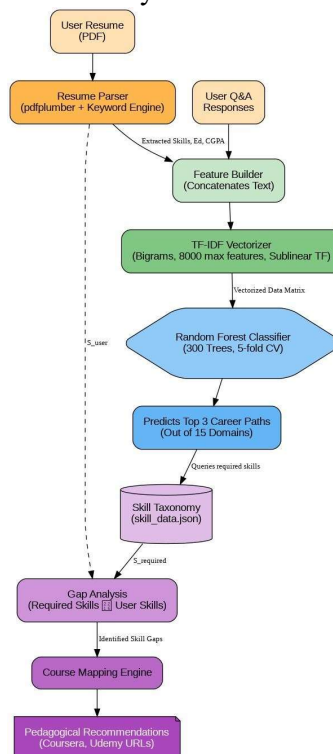


Fig. 1: Career Guidance Agent Workflow

4.2 Assignment Generation Agent

Fig.2 shows the flowchart of the process of automatic assignment generation. In this module, the faculty members have to upload the academic notes in units in the form of PDF. After that, the system would extract the information from the provided information and preprocesses it by removing any noise present in the content. Semantic topic segmentation would then be performed to detect the relevant academic topics available in the provided content. These extracted topics would be used to generate optimized prompts which will be processed by the local language model to generate assignments questions of different levels. For ensuring diversity in the content, similarity-based filters would be applied to filter out duplicates.

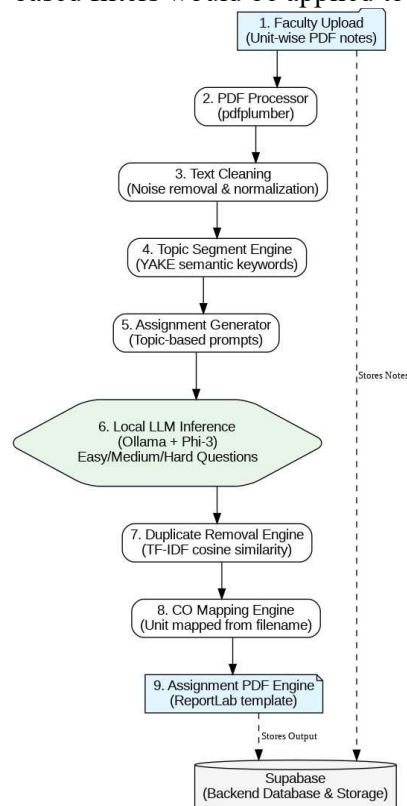


Fig. 2: Assignment Generation Agent

4.3 Question Paper Generation Agent

Figure 3 shows the flow of the automatic question paper generation module. Initially, the system loads the semesters-wise data for the syllabus. This data will be stored in a properly structured JSON file. Then the input parameters include the selection of the subject, examination type, difficulty, and structural requirements for the question. Then the examination blueprint is generated automatically by the system using those input parameters. It involves the calculation of marks and other structural requirements, including sub-parts and optionally questions. The prompt generation is done based on the syllabus and structural requirements. Then the language model trained on instructions generates the questions for the examination. This generated question paper is then processed further to get rid of unwanted tokens.

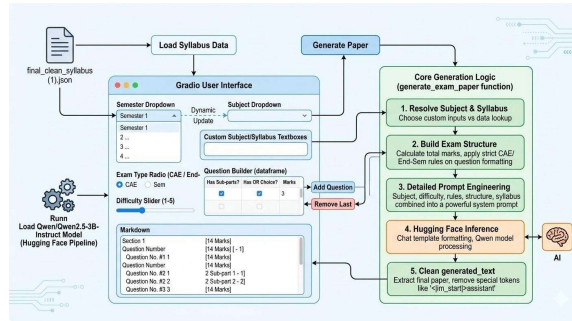


Fig.3: Question Paper Generation Agent

The importance of each term is calculated using the TF-IDF weighting scheme, where term frequency and inverse document frequency determine the relevance of words in a document.

$$TF - IDF(t, d) = TF(t, d) \times IDF(t)$$

4.4 Intelligent Query Resolution Agent

The intelligent query resolution process depicted in Figure 4 ensures that assistance to the users can be provided instantly through an interactive conversation. During the process, the institution's documents and other learning material are pre-loaded or fed into the system in smaller pieces of text. These texts are then transformed into vectors by applying the semantic representation models. Then, the texts are saved in a vector-supported database. Once the user enters a query via the app interface, the query is encoded as a vector and is used to find the most suitable information. This knowledge is further used to generate a prompt for the large language model.

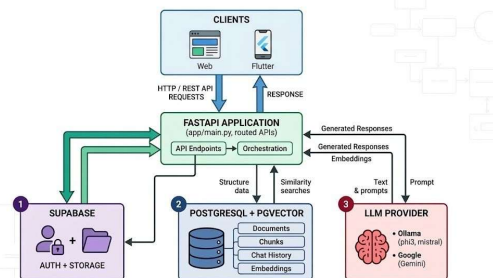


Fig.4: Intelligent Query Solver Agent

5. Expected Outcomes and Impact

The developed CampusGPT architecture can be very helpful in making academic and administrative assistance services efficient and scalable in smart campus scenarios. The use of numerous autonomous agents in the proposed architecture can help in automating many tasks related to teaching-learning activities while providing intelligent assistance to students in real time. As per expectation, the Career Guidance Agent will provide personalized career suggestions to students based on their skills while analyzing their skill gaps. The Assignment and Question Paper Generation Agents will help in generating syllabus-aligned assignments as well as question papers for examinations and other assessments.

Additionally, the Intelligent Query Resolution Agent will provide context-aware responses to academic and administrative inquiries made by students using the Retrieval-Augmented Generation technique. Thus, the above-mentioned framework can play a vital role in establishing student-centric, intelligent, and scalable smart campus ecosystems.

6. Discussion

The suggested system, namely, CampusGPT, showcases the possibilities for building an effective multi-agent framework through developing a system of artificial intelligence that could be used to provide essential academic support in smart campuses automatically. The suggested system is expected to provide effective academic support services through providing such services as personal counseling, automatic assignment and question paper generation, and answering queries. The suggested system is at the development stage at the moment and thus requires improvement in the future to assess its performance and effectiveness in terms of satisfying all the criteria of a smart campus. The suggested system will prove useful in creating an effective smart campus once the required improvements have been made.

7. Conclusion

This review paper offered a thorough analysis of autonomous multi-agent artificial intelligence for automation of smart campuses. In this regard, the paper reviewed existing literature covering multi-agent systems, retrieval-augmented generation frameworks, career recommendation models, and automatic generation of academic contents. Based on the review, it was apparent that existing intelligent solutions for campuses are primarily developed for task isolation purposes, i.e., handling specific tasks like resolving student queries, career recommendations, or generating examination papers. While these intelligent systems provide valuable insights into the potential applications of artificial intelligence in educational settings, they are not integrated, scalable, and collaborative enough.

To overcome these challenges, it is suggested that a new multi-agent artificial intelligence system called CampusGPT be proposed. CampusGPT would integrate various academic and administrative services, thereby offering a cohesive intelligent solution for smart campuses. The system will comprise different agents including a career recommendation agent, assignment generator, question paper generator, and intelligent query solver. It is expected that this paper will play a crucial role in understanding how multi-agent artificial intelligence systems can help make campuses smarter and more efficient. Moreover, it may prove instrumental in designing next-gen intelligent academic systems.

References

- [1] K. M. D., B. J. Dsouza, A. B., C. B., and S. K. N., "CAMPUS-ONE – An AI Agent for Institutional Support," *IEEE Conference*, 2025.
- [2] J. Smith et al., "Multi-Agent Systems: A Survey of Architectures and Applications," *Preprints*, 2025.
- [3] H. Modran et al., "LLM Intelligent Agent Tutoring in Higher Education using RAG," 2024.
- [4] P. K. G., S. S., T. R., J. M. C. J., and D. R., "Interactive Chatbot with AI Support for Universities," *Springer*, 2024.
- [5] M. Wooldridge, "An Introduction to Multi-Agent Systems," *Wiley*, 2009.
- [6] Z. Li et al., "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks," 2025.
- [7] P. Lewis et al., "Retrieval-Augmented Generation for Knowledge-Intensive NLP," *NeurIPS*, 2020.
- [8] S. Kumar and A. Singh, "Machine Learning-Based Career Recommendation Systems," *IJAI*, 2023.
- [9] L. Breiman, "Random Forests," *Machine Learning Journal*, 2001.

- [10] J. Swacha, "RAG Chatbots for Education: A Survey," *MDPI Applied Sciences*, 2025.
- [11] R. Campos et al., "YAKE! Keyword Extraction from Text," *Information Sciences*, 2020.
- [12] W. Hairui and W. Hua, "Multi-agent Based Test Paper Generation Algorithm," *IEEE*, 2008.
- [13] J. Johnson et al., "Efficient Similarity Search with Vector Embeddings," *IEEE*, 2019.
- [14] A. Koyama et al., "Agent-Based Campus Information System," *IEEE*, 2002.