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Nexus: A Three-Pronged Agentic AI System for Intelligent Research and Analysis

[3-Agent System](#)[Agentic ai](#)[AI](#)[Gemini](#)[LangChain](#)[LangGraph](#)[LLM](#)[Multi-Agentic AI](#)[Researcher model](#)[Serper API](#)[Mohit Kumar](#)[Diya Ravishankar](#) [Share](#)

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Abstract

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2.1 Backend (Flask & Neo4j)

Nexus is an advanced AI-powered research system designed to automate and enhance the process of gathering, analyzing, and generating structured research content. Traditional research involves **time-consuming manual searches, information filtering, and content structuring**, which can introduce inefficiencies and inconsistencies. Nexus overcomes these challenges by utilizing a **multi-agent AI architecture**, integrating natural language processing (NLP), web scraping, and AI-driven content synthesis to streamline research workflows.

2.5 Storage System

Nexus employs **three specialized AI agents**:

3. Backend Components and Code Breakdown

1. **Research Agent** – Collects real-time research data from trusted sources such as **Google Search, Wikipedia, and ArXiv**.

[View all](#)

2. **Reporting Agent** – Processes collected data and structures it into a **coherent, well-formatted research article**.

3. **Storage Agent** – Saves research outputs in **Markdown (.md), JSON (.json), and PDF** formats for accessibility and further usage.

Key features of Nexus include **customizable tone settings**, a **fact-checking mechanism using Google's Fact Check API**, and **seamless user interaction via a frontend interface built with React and Tailwind CSS**. With **automation, AI integration, and structured workflows**, Nexus significantly reduces research time, enhances accuracy, and ensures high-quality content generation.

Link to Project:

[Nexus](#) ↗

1. Introduction

Research is essential in academic, business, and technological domains, yet traditional research methods often require **significant manual effort and verification**. With the vast amount of online information, researchers face challenges such as **misinformation, scattered data sources, and the need for structured content**.

Objectives of Nexus

- Automate research workflows to reduce time and effort.
- Generate structured research articles with a logical flow.
- Verify content accuracy using fact-checking mechanisms.

- Allow tone customization for research reports.
- Enable multiple output formats (.md , .json , .pdf).

Nexus eliminates information overload and research inefficiencies by using AI-powered automation.

2. System Architecture

Nexus follows a modular AI-driven agentic architecture, where three specialized AI agents work collaboratively.

2.1 Backend (Flask & LangGraph)

- Handles HTTP requests from the frontend.
- Manages agent execution and research processing.
- Uses Flask for API development.

2.2 Agents

- **Research Agent:** Extracts raw data from multiple sources.
- **Reporting Agent:** Structures the collected data into a **technical article**.
- **Storage Agent:** Saves generated content and allows **PDF exports**.

2.3 Tools & APIs

- **Google Search API** – Fetches relevant research sources.
- **Wikipedia API** – Retrieves summarized encyclopedic content.
- **ArXiv API** – Extracts academic papers.
- **Google Fact Check API** – Ensures accuracy.

- **LangGraph** – Manages AI agent workflows.
- **WeasyPrint** – Converts research output to PDF.
- **Flask-CORS** – Enables frontend-backend communication.

2.4 Frontend (React & Tailwind CSS)

- Displays research results in an interactive UI.
- Provides a settings page for tone customization.
- Uses Framer Motion for animations.

2.5 Storage System

- Stores research outputs in .md and .json formats.
- Generates PDFs for downloadable reports.

3. Backend Components and Code Breakdown

3.1 Main Workflow (`main.py`)

The backend initializes the **workflow pipeline**, ensuring that the three AI agents execute sequentially.

```
from langgraph.graph.state import StateGraph
from config import generate_response
from state import ResearchState
from workflow_nodes import get_research, generate_news_article, save_output

def create_workflow():
    workflow = StateGraph(state_schema=ResearchState)

    workflow.add_node("research_agent", get_research)
    workflow.add_node("reporting_agent", generate_news_article)
    workflow.add_node("storage_agent", save_output)

    workflow.add_edge("research_agent", "reporting_agent")
    workflow.add_edge("reporting_agent", "storage_agent")

    workflow.set_entry_point("research_agent")
    workflow.set_finish_point("storage_agent")

    return workflow.compile()
```

This function defines the workflow:

Research Agent → Extracts research data.

Reporting Agent → Generates a structured article.

Storage Agent → Saves the article and allows PDF export.

4. Detailed Breakdown of Each Agent

4.1 Research Agent (Data Collection)

The Research Agent collects data from multiple sources and fact-checks the results.

```
def get_research(state: dict) -> dict:
    research_tool = ResearchTool()
    topic = state["topic"]

    google_results = research_tool.search_google(topic)
    wiki_results = research_tool.search_wikipedia(topic)
    arxiv_results = research_tool.search_arxiv(topic)
    fact_check = research_tool.fact_check(topic)

    research_summary = f"Google: {google_results}\n\nWikipedia: {wiki_results}\n\nArxiv: {arxiv_results}"

    return {"research_summary": research_summary, "fact_check_results": fact_check}
```

4.2 Reporting Agent (Content Generation)

The Reporting Agent converts research data into a structured article.

```
def generate_news_article(state: dict) -> dict:
    research_state = state

    if not research_state["research_summary"].strip():
        research_state["article"] = "No research data available."
        return research_state

    article_prompt = f"""
Based on the following research, write a compelling and detailed news article:

{research_state["research_summary"]}

**Ensure the article follows this format:**
- **Title**
- **Introduction**
- **Key Insights**
- **Industry Impact**
- **Future Prospects**
- **Conclusion**
"""

    response = generate_response(article_prompt)
    research_state["article"] = response.strip()

    return research_state
```

4.3 Storage Agent (Data Persistence)

The Storage Agent saves research results in `.md` and `.json` formats.

```
def save_output(state: ResearchState) -> dict:
    topic = state["topic"].replace(" ", "_")
    article = state["article"]
    research_summary = state["research_summary"]

    if not article.strip():
        state["message"] = "⚠️ No article content to save."
        return state

    article_path = os.path.join(BASE_DIR, f"{topic}.md")
    json_path = os.path.join(BASE_DIR, f"{topic}.json")

    os.makedirs(BASE_DIR, exist_ok=True)

    with open(article_path, "w", encoding="utf-8") as f:
        f.write(f"# {topic}\n\n{article}")

    return state
```

5. Results

Nexus successfully streamlines the research process through automation, AI-driven content generation, and structured workflows. Below are the key outcomes observed:

5.1 Functionality Demonstration

- **Automated Research:** Extracts **real-time** research data from **Google, Wikipedia, and ArXiv**.
- **AI-Generated Content:** Produces **coherent, structured** articles.
- **Customizable Tone:** Allows users to select the **tone** of the article (formal, technical, simplified, etc.).
- **Multi-Format Storage:** Saves research output in **Markdown (.md), JSON (.json), and PDF**.
- **Fact-Checking:** Verifies accuracy using **Google Fact Check API**.

- **Interactive UI:** Displays results in an **intuitive frontend interface**.
- **PDF Generation:** Provides **downloadable** research reports.

5.2 Example Output

Topic: *Impact of AI on Healthcare*

Generated Article:

1. Introduction

- Overview of AI in healthcare.

2. AI-Driven Diagnostics

- How AI assists in disease detection.

3. Future Trends

- The future role of AI in medicine.

4. Conclusion

- Summary and impact.

6. UI/UX (Frontend)

Nexus features a **modern, responsive UI** that allows users to input a topic, process research, and view/download results. Below are images illustrating different sections of the UI.

6.1 Home Page

Description: The homepage where users can enter a research topic.

The screenshot shows the Nexus AI research interface. At the top left is the Nexus logo. On the right are icons for refresh, settings, and user profile. The main title "Research Powered by AI" is displayed in large blue letters. Below it is a subtitle: "Discover insights, analyze data, and find answers with our advanced AI research assistant." A search bar contains the placeholder text "Ask any research question... (Press '/' to focus)". To the right of the search bar is a blue "Research" button. Below the search bar are two buttons: "View Examples" (blue) and "Learn More" (white). The background features a dark blue gradient with abstract white shapes.

Powerful Research Capabilities

6.2 Research Processing

Description: The system processing the research request in real-time.

 **Nexus**

[← Back to Home](#)

Research Results

Topic: "Baby"

Research Progress



20%

Initializing Searching Analyzing Synthesizing Complete

Searching for sources...

Processing your query

Searching for relevant sources...

Nexus AI

Links

Connect

The screenshot shows the Nexus AI system interface. At the top, there's a navigation bar with icons for time, settings, user, and refresh. The main header "Nexus" is on the left, and the sub-header "Research Progress" is in the center. Below the sub-header is a horizontal bar with five stages: Initializing, Searching, Analyzing (which is highlighted in blue), Synthesizing, and Complete. The progress is at 40%, with the message "Analyzing content..." below the bar. On the left, under "Sources Found", there's a large blue circle labeled "Query" connected by lines to three smaller circles representing search results. Below this, three cards show search results:

- Google: Baby-Friendly USA is the accrediting...** 100%
Baby-Friendly USA is the accrediting body for the US Baby-Friendly
- Wikipedia: In common terminology, a baby...** 67%
In common terminology, a baby is the very young offspring of
- Arxiv: <?xml version="1.0" encoding="UTF-8"?>...** 33%
<?xml version="1.0" encoding="UTF-8"?> <feed>

The screenshot shows the Nexus AI interface. At the top, there's a navigation bar with icons for home, search, and user profile. A search bar on the right contains the placeholder text "Ask any research question... (Press '/' to focus...)". Below the search bar, the title "Research Results" is displayed, followed by the topic "Topic: 'Quarks'". A "Research Progress" bar indicates the process is 70% complete, with stages: Initializing, Searching, Analyzing, Synthesizing (which is highlighted in blue), and Complete. A message below the progress bar says "Synthesizing results...". On the left, a section titled "Processing your query" shows the status "Synthesizing information". At the bottom, there are three columns: "Nexus AI" (described as an advanced AI-powered research assistant), "Links" (with links to About, Privacy Policy, and Terms of Service), and "Connect" (with social media icons for LinkedIn, Twitter, and Email). The footer contains the copyright notice "© 2025 Nexus AI. All rights reserved."

6.3 Results Display

Description: A detailed article is displayed with structured content.

The screenshot shows the Nexus AI system's interface for research results. At the top, there is a navigation bar with icons for search, settings, user profile, and help. The main title is "Research Results" with a subtitle "Topic: 'Quarks'". On the right side of the header is a search bar with placeholder text "Ask any research question... (Press '/' to foc..." and a "Research" button. Below the header, there is a section titled "Quarks" with a sub-section "Completed on 3/11/2025, 8:33:09 AM". There are three buttons: "Save", "Share", and "Export". A navigation bar at the bottom includes tabs for "Article" (which is selected), "Sources & Visualization", and "Visualizations". The main content area contains several sections: "Delving Deeper into the Heart of Matter: Understanding Quarks", "Introduction", "Key Insights", "Confinement", "Types", "Fundamental Force", and "Industry Impact". Each section contains descriptive text about quarks.

Delving Deeper into the Heart of Matter: Understanding Quarks

Introduction:

Quarks, the fundamental building blocks of matter, have long captivated scientists. These elusive particles, never observed in isolation, are the key components of protons and neutrons, residing at the core of every atom. Recent research continues to shed light on these enigmatic particles, deepening our understanding of the universe's fundamental structure. From theoretical explorations on arXiv to the surprisingly relevant world of e-commerce, the word "quark" has taken on a multifaceted meaning, highlighting the importance of clear scientific communication.

Key Insights:

Our understanding of quarks stems primarily from observing hadrons, composite particles formed by the strong force binding quarks together. The most common hadrons are protons and neutrons, which form the nuclei of atoms. Key properties of quarks include:

Confinement: Quarks are never found alone due to a phenomenon called color confinement. They exist only within hadrons or in extreme conditions like quark-gluon plasmas.

Types: Several types or "flavors" of quarks exist, including up, down, charm, strange, top, and bottom. Protons and neutrons are composed of up and down quarks.

Fundamental Force: The strong force, mediated by particles called gluons, binds quarks together within hadrons.

Research on arXiv, a preprint server for scientific papers, reveals extensive ongoing investigation into quark behavior. A search reveals over 60,000 articles related to quarks, covering a wide range of topics, from the properties of quark matter to the theoretical existence of quark stars. One example found delves into the "Isovector properties of quark matter and quark stars," indicating ongoing theoretical work on the behavior of quarks under extreme densities.

Industry Impact:

6.4 Settings Page

Description: Users can adjust the tone of the research article.

Settings

Customize your research experience

Research **Display** **Privacy**

Research Depth

Control how thorough the AI should be when researching topics

Basic - Quick results with essential information
 Standard - Balanced depth and speed
 Deep - Comprehensive analysis with detailed insights

Maximum Sources

Set the maximum number of sources to include in research results

3 Current: 5 10

Recency Preference

Control how recent the sources should be

Any time - Include all relevant sources regardless of date
 Recent - Prioritize sources from the past few years
 Very recent - Focus on the most recent sources

7. Conclusion

Nexus provides an AI-powered solution for efficient, accurate, and structured research. By automating information retrieval, content synthesis, and storage, Nexus eliminates the manual workload traditionally associated with research.

7.1 Key Takeaways

- AI-driven research automation significantly reduces research time.

- Structured article generation ensures clarity and readability.
- Fact-checking integration enhances credibility.
- Multi-format storage options make research results more accessible.

7.2 Future Enhancements

- Cloud-based storage for persistent access to research history.
- Integration with additional research sources for broader knowledge coverage.
- Support for multiple languages for global accessibility.
- Advanced AI models for more nuanced content generation.

8. Tech Stack

Nexus is built using **modern web technologies** to ensure efficiency, scalability, and a seamless user experience.

8.1 Frontend

- **React.js** → Frontend framework for UI development.
- **Tailwind CSS** → Utility-first styling for a modern, responsive interface.
- **Framer Motion** → Smooth animations and UI interactions.

8.2 Backend

- **Flask** → Python-based backend framework for API handling.
- **LangGraph** → Manages agent workflow execution.
- **WeasyPrint** → Converts research output to PDF.

8.3 APIs & AI Models

- Google Search API → Retrieves online research data.
- Wikipedia API → Fetches encyclopedic knowledge.
- ArXiv API → Extracts academic research papers.
- Google Fact Check API → Verifies claim authenticity.
- Google Gemini API → AI-driven text generation for structured content.

Comments ▾

Files

[Download example_output.pdf](#)



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Deep Research Mode

Research Settings

Writing Style	Language	Citation Format
Select writing style <input checked="" type="radio"/> Academic <input type="radio"/> Business	Select language <input checked="" type="radio"/> English <input type="radio"/> Spanish	Select citation style <input checked="" type="radio"/> APA <input type="radio"/> MLA

AI Agent Based Deep Research

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AI Research Agent

ahmadsanafarooq/Multi-Agent_Research_A... Running App Files Community Settings

Multi-Agent Research Assistant (LangChain Only)

Enter a topic below and the AI agents will collaborate to create a research report for you.

Research Topic
The future of AI in healthcare

Start Research

Research Report
Senior Technology Report: The Transformative Impact of Artificial Intelligence in Healthcare

Introduction:
Artificial Intelligence (AI) is rapidly reshaping the healthcare landscape, ushering in an era of unprecedented advancements in diagnostics, treatment, and delivery of care. This report examines the key trends driven by AI in healthcare, highlighting its transformative potential while acknowledging the associated challenges and the need for responsible implementation. The integration of AI is not merely an incremental improvement; it represents a fundamental shift in how healthcare is approached, promising to improve efficiency, accessibility, and ultimately, patient outcomes.

Multi-Agent Research Assistant

12/12/25, 5:03 PM

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Start Research Progress Results

Research Assistant Crew

Enter your research question and our AI agents will work together to provide you with a comprehensive answer.

Research Question *

Enter your research question here...

Research Depth

Standard (15 min)

Output Format

Full Report

Z

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