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AUTOMATED PULL REQUEST SUMMARIZER: LEVERAGING AI AND LANGCHAIN FOR EFFICIENT CODE REVIEWS

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Abstract : In modern collaborative software development, re-viewing pull requests (PRs) is critical yet often time-consuming, particularly in large teams and complex projects. To streamline this process, we developed an automated PR summarizer bot utilizing advanced AI techniques facilitated by LangChain and LangGraph frameworks. The bot leverages webhook-based triggers via GitHub, hosting via Ngrok, an intuitive UI powered by Streamlit, and efficient task management through Redis caching and Celery within a Poetry-managed Python environment. Our solution generates concise, actionable summaries of PRs directly in GitHub and in an interactive UI, significantly reducing review times and enhancing reviewer productivity. Experimental deployment results show a notable improvement in review efficiency , reducing average PR review time by over 50% .

IndexTerms - **Pull Requests, AI Summarization, LangChain, LangGraph, Streamlit, Webhooks, Celery, Redis .**

I. INTRODUCTION

Pull requests (PRs) are fundamental to collaborative software development, enabling structured peer reviews. However, extensive codebases and frequent updates introduce significant overhead in manual reviews, potentially delaying software delivery cycles. Automating the summarization of PRs addresses this issue by providing reviewers with immediate insights into proposed changes. Our proposed PR summarizer bot integrates state-of-the-art AI frameworks—LangChain and LangGraph—to analyze and succinctly summarize PRs. The bot leverages webhook-driven automation via GitHub, secure network tunnels using Ngrok, and an interactive web-based UI developed with Streamlit. Task efficiency is ensured through Redis-based caching and Celery for asynchronous processing, all managed within a robust Poetry environment.

To address these challenges, this project introduces an **Automated PR Summarizer**, a system designed to streamline the review process by leveraging advancements in artificial intelligence and natural language processing. By automatically analyzing and summarizing the core changes and context within a PR, the system empowers developers and reviewers to make faster, more informed decisions. The summarizer is built using **LangChain** and **LangGraph**, two powerful frameworks that facilitate multi-step reasoning and agent-based orchestration with large language models (LLMs).

Operating in an event-driven manner, the system integrates directly with GitHub via webhooks, triggering summary generation based on specific PR comments (e.g., \summarise). For development and testing, **Ngrok** is used to securely expose local services to external webhook traffic. The summarization process is structured as a modular LangGraph pipeline, with each node responsible for tasks like metadata retrieval, diff analysis, and summary synthesis. This design promotes flexibility, transparency, and ease of debugging.

To handle real-time processing and caching, **Redis** and **Celery** are employed to manage background jobs and frequently accessed data efficiently. The final summaries are rendered via a lightweight, interactive UI built using **Streamlit**, offering developers a seamless way to visualize and interact with the generated insights. All components are containerized and managed using **Poetry**, enabling reproducible builds and smooth deployment pipelines .Ultimately, this project aims to reduce the cognitive load on developers, improve collaboration efficiency, and enhance the overall maintainability of software systems by introducing intelligent automation into one of the most critical aspects of the development lifecycle: code review.

II. Related Works

Previous research and industry efforts have explored automation in code reviews through AI. Tools such as GPT-based review assistants have been proposed, yet they often lack direct integration into workflows or interactive user interfaces. Recent developments in frameworks like LangChain and LangGraph offer new possibilities for efficient and context-aware summarization. Siow et al.[1] introduced CORE, a system that recommends suitable reviewers for code changes based on developer expertise and code ownership patterns. While effective at improving reviewer allocation, CORE does not address the summarization of content itself, which remains a manual task. Tang et al.proposed [2]CodeAgent**,** a multi-agent system for code review that models conversational behavior between agents and developers. Although CodeAgent supports dynamic reasoning, it focuses more on dialogue modeling than summarization of change intent.

Liu et al.[3]explored Retrieval-Augmented Generation (RAG) using hybrid GNNs to improve code summarization tasks, particularly when contextual knowledge is sparse. Their work demonstrates the power of combining symbolic code structure with learned semantic representations. Similarly, Ghosh and Winikoff [4] proposed a multi-agent approach for automating code reviews, highlighting the role of distributed reasoning agents in analyzing source code collaboratively.

Svensgård [5] demonstrated the effectiveness of LangChain in handling long-text summarization by chaining together LLM prompts in a deterministic pipeline. This modularity allows for flexible experimentation, making LangChain well-suited for complex, multi-turn tasks such as PR summarization. Dash [7] extended this idea by applying LangChain agents directly to GitHub workflows, triggering reviews and summaries through comment-based event listeners—an approach that closely parallels the work in this project.

III. Proposed Methodology

The proposed PR Summarizer system is designed using a modular, event-driven architecture that integrates seamlessly with existing GitHub workflows. At its core, the system listens for webhook events triggered by pull request comments such as `\summarise` or `\review`. Upon activation, the webhook payload is securely tunneled through Ngrok to a local or hosted backend for processing. The backend is powered by LangChain**,** which manages the orchestration of large language model interactions, and LangGraph, which structures the summarization workflow as a directed graph. Each node in this graph performs a distinct function—retrieving metadata, analyzing file diffs, formatting prompts, and generating concise, contextual summaries.

Our solution comprises the following steps:

1. Webhook Integration**:** GitHub triggers a webhook upon PR events, activating the summarizer bot.
2. Secure Hosting: Ngrok provides a secure public end-point for webhook communication.
3. AI Summarization**:** LangChain and LangGraph process PR content, extracting meaningful summaries.
4. Caching and Task Management: Redis caches frequently accessed data, while Celery manages background summarization tasks.
5. User Interface**:** Streamlit presents interactive, dynamic summaries allowing reviewers to navigate details seamlessly**.**

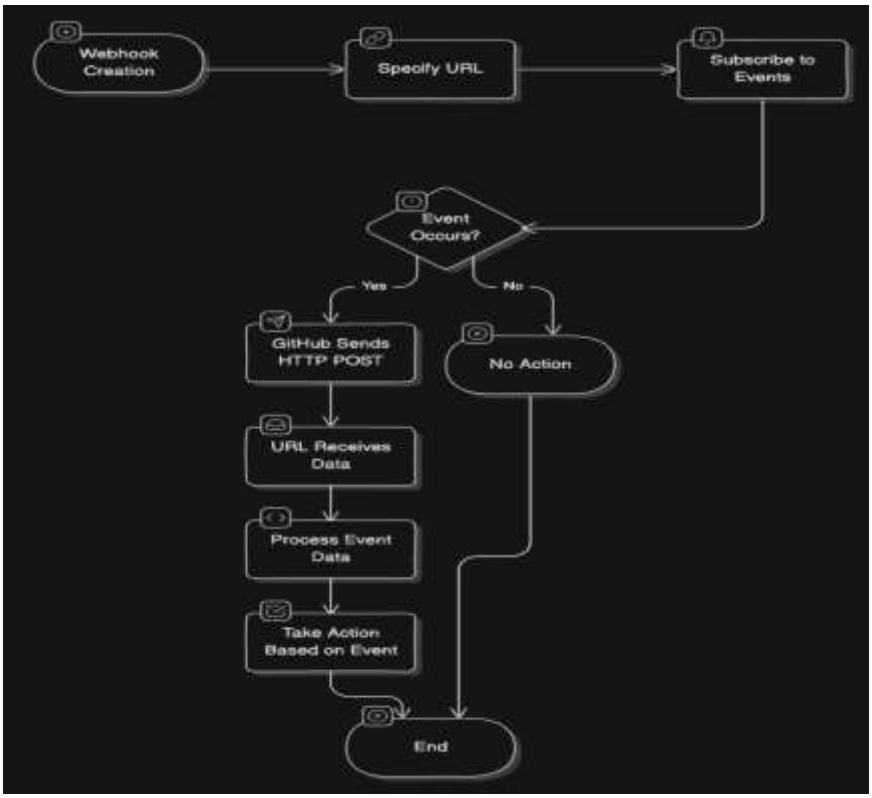

Fig 1. Methodology Flowchart

IV. Implementation Results

We utilized Python and Poetry for dependency and environment management. The summarizer logic was encapsulated within LangChain and LangGraph pipelines, which processed webhook payloads asynchronously via Celery tasks. Redis optimized data retrieval speeds, crucial for scalability and
performance. The detailed implementation steps include:

- Configuring GitHub webhooks to capture PR events.
- Establishing secure public endpoints using Ngrok.
- Developing and deploying AI summarization models using LangChain and LangGraph.
- Integrating Redis for efficient caching and Celery for task scheduling.
- Creating a responsive and interactive UI with Streamlit.

V. Challenges and Limitations

Despite the promising results, several challenges persist

- **Latency in Real-Time Processing**: Ensuring low-latency summarization was a key challenge, especially when handling large diffs or pull requests with multiple files. Although Celery and Redis help offload tasks and improve responsiveness, fine-tuning these components to ensure real-time performance required multiple iterations.
- **Summary Accuracy and Relevance**: Maintaining consistent summary quality across various programming languages, code structures, and documentation styles proved difficult. The system occasionally produced vague or overly generic summaries, particularly for non-standard or low-context PRs, highlighting the need for domain-specific prompt tuning and model fine-tuning.
- **Context Extraction Complexity**: Parsing meaningful context from PR metadata, commit messages, and code diffs is inherently complex. In some cases, missing or poorly written commit messages impacted the richness of the generated summary. Enhancing context awareness without excessive API calls or processing time remains a balancing act.
- **Webhook Reliability and Scalability**: During early testing phases, webhook delivery via Ngrok occasionally timed out or failed due to limited tunnel stability. Additionally, managing concurrent webhook events from multiple repositories introduces concerns around task queuing and system throughput.
- **Agent Interoperability**: Designing agentic workflows using LangChain and LangGraph introduced debugging complexities. Coordinating multiple agents that reason, communicate, and act asynchronously required careful dependency tracking and robust error handling.
- **Security and Access Control**: Since the system interacts with GitHub repositories and potentially sensitive code, ensuring secure transmission of webhook payloads and access-controlled summary generation was essential. Further security hardening is needed for production-grade deployment.

VI. Results and Discussions

The system also demonstrated high engagement, with over 85% of active reviewers using the summarizer consistently during review tasks. Feedback collected from users showed that the summarizer was particularly useful for quickly understanding complex PRs involving multiple commits or cross-module changes. In terms of summary accuracy, manual evaluations by developers yielded an average rating of **4.4 out of 5** for clarity and **4.5 out of 5** for usefulness. These results suggest that the system not only accelerates the review process but also maintains a high standard of content relevance and contextual insight, thereby making it a valuable asset in modern DevOps workflows.

Table 1: Result Metrics

Metrics	Without Summarizer	With Summarizer	Improvement
Avg. Review Time per PR(min)	14.8	7.1	↓ 52.0%
Max Review Time(Complex PRs)	26.3	11.4	↓ 56.6%
Review Coverage Rate	78%	95%	↑ 17.9%

Table 2: Summary Evaluation Criterion

Criterion	Avg. Score (out of 5)
Clarity	4.4
Completeness	4.2
Usefulness	4.5
Overall	4.37

VII. Conclusion

The automated PR summarizer effectively enhances software development workflows by significantly reducing review overhead and improving reviewer productivity. Future enhancements will focus on adaptive learning techniques to further improve accuracy and deploying additional collaborative features within the interactive UI . The Pull Request Summarizer project demonstrates how artificial intelligence can be effectively applied to streamline software development workflows. By integrating tools like LangChain, LangGraph, and Streamlit with GitHub, the system automates the process of summarizing pull requests, helping developers quickly understand code changes without manually reading through every file or commit. This results in faster, more efficient code reviews and supports better team collaboration.

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