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AI-Powered GitHub Repository Summarizer with CrewAI: Automating Codebase Analysis

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ABSTRACT
Manually reviewing large and complicated codes is time-consuming and labor-intensive. It takes a lot of time and effort to read huge and complex code projects and understand them. Such an effort is a time-consuming and not efficient process. Modern software contains thousands of files; hence, it is very difficult to understand its architecture, features, and key components easily. To address these challenges, there is a need for an automated system that can summarize, clone, and analyze GitHub repositories. Such a system should be capable of handling large and complex repositories while reducing the amount of human effort required. This paper presents an automated solution using a multi-agent system powered by Crew AI to summarize and analyze GitHub repositories. This system employs specialized agents that collaboratively clone repositories, parse key files (e.g., README, source code), and extract relevant functional and architectural insights. The backend is implemented in Python, using GitPython for repository management and large language models via OpenAI for semantic analysis. These agents operate in parallel to perform source code inspection, document analysis, and report generation. The output is human-readable, easily understandable, and structured, presented in multiple formats, such as PDF, Markdown, or JSON. This framework significantly reduces manual efforts and enables the creation of a scalable codebase understanding, making it a practical tool for developers, researchers, and automated documentation pipelines.

KEYWORDS
Code summarization; Crew AI; GitHub analysis; multi-agent systems; repository mining; automation; software architecture

1. INTRODUCTION

This work introduces a GitHub Repository Summarizer developed using Crew AI, a framework that supports collaborative agents. The system is able to clone repositories, locate the most relevant files, and use specialized agents to examine both documentation and source code. The analysis is then organized into a structured summary that outlines project features, architecture, and core modules. The framework makes use of Python for backend processing, GitPython for repository handling, and advanced language models for semantic analysis, enabling it to provide precise and concise overviews of complex software projects.

The main goal of this work is to give developers and researchers a practical tool that reduces the effort required to manually go through large codebases, while also improving their understanding and overall productivity. Unlike the usual methods, this system not only speeds up the analysis process but also provides results in different formats, making it easy to use within larger automated workflows. This approach supports the advancement of modern software engineering by showing how smart, collaborative systems can simplify repository exploration and make development tasks more efficient.

In the present era, open-source development and software repositories are growing at unprecedented levels.

Platforms like GitHub host millions of projects, ranging from small utilities to highly complex frameworks. It consists of thousands of files. Understanding, which is often a challenging task, because this requires developers to manually check the documentation, review the source code, and identify its architecture. We suggest making use of the code's developer-assigned identifiers. In order to make the code easier to read, developers often use informative identifiers while developing programs. This helps to maintain rich code semantics [20]. Iterative prompt refinement using manual prompt engineering methodologies, such Chain-of Thought (CoT) reasoning, necessitates a substantial amount of human labor.

Subjective bias and scalability problems plague this time-consuming procedure, making it challenging to generalize across a variety of jobs [21]. Automatic code summarization systems have become widely used as a result of these developments, improving code readability, maintainability, and comprehension in general [22]. In contrast to earlier methods that used conventional models for code summarization, pre-trained language models (PLMs) provide a multitude of past knowledge that is ingrained in their parameters and obtained during the lengthy pre-training stage [23]. This process is not only time-consuming but also requires significant technical expertise.

Open-source software has fundamentally changed how we view the software development process [1]. GitHub is a widely used platform for hosting code that works with Git for source

code management. In addition to storing software projects, it also brings in the social side of development. Every user on GitHub has a public profile, and their activities can be seen and followed by others in the community. This way of linking a developer's identity with their work and contributions makes GitHub stand out from other platforms [2]. The bulk of projects are freely shared with the world via GitHub, the biggest open source software marketplace. One or more README.MD files are included with every GitHub repository to offer basic information about the repository, such as help, instructions, or information on updates, to mention a few. To represent information in an understandable manner, such a file is presented in the Markdown format [18].

More than 420 million repositories, including at least 28 million public repositories, and more than 100 million developers were listed on GitHub as of January 2023. As of June 2023, it is the biggest source code host in the world [16].

Git's capability is expanded by GitHub, which provides a centralized platform with a number of collaboration tools. Because it offers repository hosting, managing, sharing, and storing data is simple. Git repositories Strong collaboration features like pull requests, problems, and project boards are also included in GitHub, which facilitate team communication and let engineers debate and examine changes before incorporating them into the main source. GitHub allows teams to automate testing, deployment, and other processes right within the platform by integrating with CI/CD (Continuous Integration and Continuous Deployment) technologies platform [26].

In the industry, automated code review solutions are becoming more and more popular [3]. However, there is limited practical evidence about the real advantages of these tools. For instance, while automated reviews may appear to save time, they can also create new issues that reduce this benefit. Likewise, the savings from lowering developer effort may not be significant when compared to the expenses involved in maintaining and running such tools [13]. Developers take the time to comprehend the work of other developers and its position within the project in order to do a code review [14]. We suggest making use of the code's developer-assigned identifiers. In order to make the code easier to read, developers often use informative identifiers while developing programs. This helps to maintain rich code semantics [19].

Developers invest effort in comprehending the code update, searching for errors, and identifying performance snags or general departures from coding standards in order to produce code reviews. Several attempts have been made to give code reviews using pre-trained models [15]. Research on automatic code summarization is growing quickly. Programmers are known for ignoring the labor-intensive process of creating their own summaries, and automation has long been mentioned as a preferable substitute [17].

2. PROBLEM STATEMENT

2.1 Time consuming:

When a software project grows large, it often contains thousands of files, with each file having hundreds or even thousands of lines of code. To understand such a project, a developer usually has to open file after file, read through the logic, follow how different functions interact, and connect this information to the overall structure of the system. This process is slow because code is often spread across multiplefolders, written in different programming languages, and may not always be documented clearly.

2.2 Inefficient and scalability issue:

Developers usually look for an overall understanding of how a project works such as its main modules, workflows, and dependencies without needing to read every single line of code. However, in practice they often end up scanning through thousands of lines spread across many files just to piece together that bigger picture, which wastes time and energy. This becomes even harder when teams handle several repositories at once, because the same slow, manual process has to be repeated for each one. As the number of repositories grows, this approach quickly becomes unmanageable, making it difficult to keep up with the pace of development.

3. OBJECTIVES

Building a system that can automatically replicate and analyze the contents of public GitHub repositories is the primary objective of this study. It collects useful information from documentation, source code, and configuration files, while dividing the work into smaller, organized steps to make the process more efficient. Using the collected details, the system prepares a clear and structured summary of the project. The final results are provided in multiple formats such as PDF, JSON, or Markdown, making them convenient for use in different environments and workflows.

4. Methodology

This work's methodology is based on a structured pipeline that automates repository analysis and summary. To make a local working copy, GitHub repositories were first gathered and cloned. README, documentation, and source code were found to be the main project files used for analysis. Project descriptions and background information were extracted using a documentation reader module, and the program architecture and functional elements were analyzed using a code analyzer. After the insights were retrieved, a summary writer module combined them to create a logical overview of the repository. Following processing, the data was organized into structured reports and exported in a variety of formats, including Markdown, JSON, and PDF, to guarantee accessibility and simplicity of distribution.

The study was conducted using a set of precise procedures. For local access to the files, GitHub repositories were first cloned. The README, documentation, and source code were then identified as important files. After that, the source code was examined to learn about its structure and functionality, and the documentation was studied to comprehend the project. This data was gathered, and a summary that synthesized the results into

an understandable project description was produced. The results were finally transformed into reports, which were then published in Markdown, JSON, and PDF forms. This methodical approach guarantees dependable results and makes the process easy to replicate.

The study used an organized but simple procedure to evaluate and compile GitHub repositories.

The strategy is guaranteed to be scalable, repeatable, and able to yield consistent results across many repositories thanks to this standardized process.

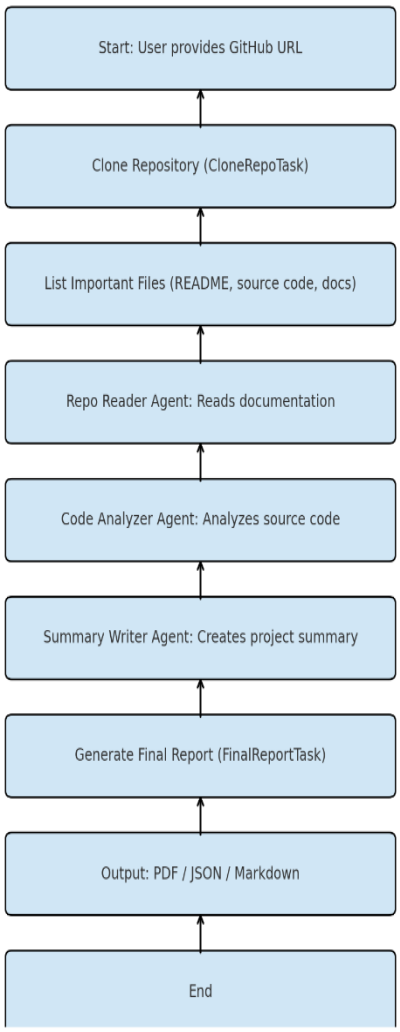

Fig. 1 Workflow of the System

Figure 1 illustrates the system's sequential operation, beginning with a user-provided GitHub URL. Agents read the source code and documentation after cloning the repository and identifying the important files. The results of this analysis are used to build a summary, which is then used to create a full report that gives a clear overview of the project in formats like PDF, JSON, or Markdown.

5. FRAMEWORK AND TOOLS

GitPython is used to manage the cloning and repository organization process, while Python is used to construct the system's backend functions. The framework is designed to break down tasks into smaller modules that work together, making it easier to process different parts of the project in an orderly way. For analyzing the content of files such as documentation and source code, advanced language processing methods are applied to identify structure and meaning. To maintain accuracy and consistency, Pydantic is used to define and validate data models, ensuring that the information extracted is clean, reliable, and ready for further use.

5.1 Python:

Python is a general-purpose, high-level, interpreted programming language that runs code immediately without requiring compilation first. It follows dynamic typing, which allows variables to change type during execution, and employs automatic memory management through garbage collection. Python is often described as being "batteries included," meaning that it comes with a large standard library of modules that can be used for a variety of tasks. This makes Python suitable for rapid development and a broad range of applications in both research and industry. It is renowned for being straightforward, readable, and adaptable, which makes it a solid option for a variety of applications. [4].

5.2 CrewAI:

An open-source framework called CrewAI was developed to arrange and manage intelligent software agents through autonomous and role-based operations, allowing them to collaborate to solve challenging issues. It enables developers to give these agents defined roles, goals, and resources, guaranteeing organized cooperation. The framework is built around core components such as Agent, Task, Tool, and Crew, which can be flexibly combined to design multi-agent systems tailored to different requirements. It also integrates with widely used APIs, including OpenAI and Ollama, and offers important features such as role-specific agents, automated task distribution, and adaptable task management. CrewAI is particularly suited for managing complex processes like multi-step workflows, collaborative decision-making, and problem-solving in dynamic environments [5]. An open-source framework called CrewAI was created to manage AI agents with autonomous and role-playing capabilities to promote agent collaboration in the resolution of challenging issues [24]. A task, as defined by the CrewAI architecture, is the precise job completed by an agent, containing information about the task's description, executing agents, and necessary tools. Through the Crew's process orchestration, it facilitates multi-agent collaboration and maximizes teamwork and efficiency [25].

5.3 GitPython:

GitPython offers a structured way to interact with Git repositories through an object-oriented model. The tutorial is organized into several sections, each focusing on a practical example to demonstrate its usage. The code examples provided

are taken directly from the test_docs.py file to ensure accuracy and reliability. This approach also enables researchers and developers to reproduce the results easily by setting up a standard developer installation of GitPython [6].

5.4 OpenAI / Azure OpenAI:

These are a number of Microsoft-provided cloud-based AI products and APIs that have seen tremendous growth in recent years. A number of cloud-based products and APIs that Microsoft provides have grown in popularity in recent years. These services give developers access to a variety of pre-trained models for tasks including audio analysis, text management, and natural language processing. They support diverse applications, including automated content generation, language translation, sentiment evaluation, and anomaly detection. Through Azure OpenAI Services, organizations can utilize advanced models directly from the cloud without the need to build or maintain extensive computational infrastructure [7].

5.5 Pydantic:

Pydantic is a Python library used to define data models and check their correctness. In real-world applications, data often comes from different sources such as user inputs, databases, or external systems. It is important to verify that this data is accurate and consistent before using it in the application. Without proper checking, invalid data may cause errors, security issues, or unexpected behavior during execution [8].

5.6 LitLLM:

LitLLM also uses a modular pipeline, taking inspiration from the GitHub Repo Summarizer's process as detailed in the PDF. That project involves cloning repositories, reading source code and documentation, and having specialist modules examine the key elements before generating a clean report. In a similar vein, LitLLM uses a pipeline that steps through information: it finds research papers that are connected to a repository, examines supporting documentation, and gathers the results into a structured draft for a literature review [9].

5.7 LangChain:

A flexible and modular method for creating applications driven by large language models (LLMs) is provided by the quickly developing LangChain framework. Developers may streamline difficult phases of the application lifecycle, including development, productionization, and deployment, by utilizing LangChain, which facilitates the creation of scalable, applications that are contextually aware and stateful [10]. As a potent framework created to overcome these issues in creating LLM-powered apps, LangChain has quickly become well-known [11]. By making it easier to integrate LLMs into a variety of applications, LangChain gives developers the ability to produce solutions that are not only useful but also effective and safe. Its compatibility with features such as retrieval augmented generation (RAG) and conversation models [12].

````
## Requirements

1. Python 3.8 or higher
2. Create a Virtual Environment (Optional but Recommended)
```bash
python -m venv venv
source venv/bin/activate        # On Linux/Mac
venv\Scripts\activate           # On Windows
```
3. Install Dependencies
```bash
pip install -r requirements.txt
```

4. Create a `.env` File
   - Create a `.env` file in the root directory of the project.
   - Add the following fields to the `.env` file:
     ```properties
     model=""
     AZURE_API_KEY=""
     AZURE_API_BASE=""
     AZURE_API_VERSION=""
     ```
   - Replace the placeholders with your actual values:
     - `model`: Specify the model name (e.g., `azure/gpt-4o-mini`).
     - `AZURE_API_KEY`: Add your Azure OpenAI API key.
     - `AZURE_API_BASE`: Add your Azure OpenAI API base URL.
     - `AZURE_API_VERSION`: Add the API version (e.g., `2025-04-27`).

---
````

Fig. 2 Requirements and Setup Instructions

Figure 2 describes how to set up the project environment, including installing Python, creating a virtual environment, setting up dependencies, and specifying the model, API key, base URL, and version of Azure OpenAI in a.env file for safe and seamless integration.

6. ARCHITECTURE OVERVIEW

The proposed system follows a structured workflow that ensures the efficient analysis of GitHub repositories. The process begins with cloning the repository through its URL, which allows the system to access all project files locally. Once the repository is available, the framework automatically identifies and lists key files, such as the README file, source code files, configuration files, and other relevant documents that provide insight into the project's structure and functionality.

After identifying the important components, the system assigns specific tasks to multiple agents, where each agent is responsible for analyzing different aspects of the repository. For example, one agent may focus on documentation, while another examines the source code or project dependencies.

The final stage of the process involves integrating the outputs from all agents to generate a structured and comprehensive analysis report. This report can be exported in different formats such as PDF, JSON, or plain text, depending on the requirements. Such flexibility makes the system suitable for both technical evaluation and broader documentation purposes, ensuring accessibility across diverse applications.

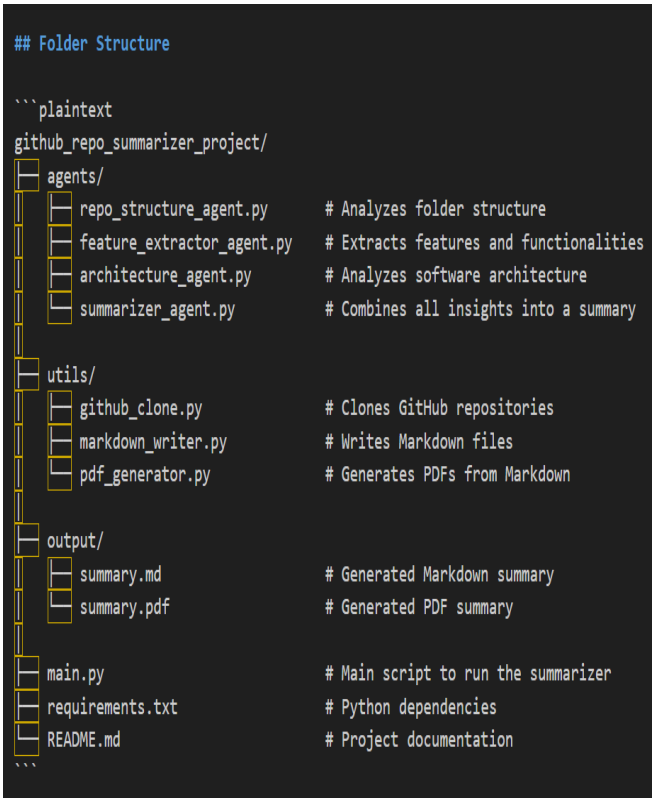

Fig. 3 Folder Structure

Figure 3 illustrates the project's organized structure, which guarantees modularity and clarity in execution by having distinct folders for agents, tools, outputs, and core files.

7. RESULTS AND DISCUSSION

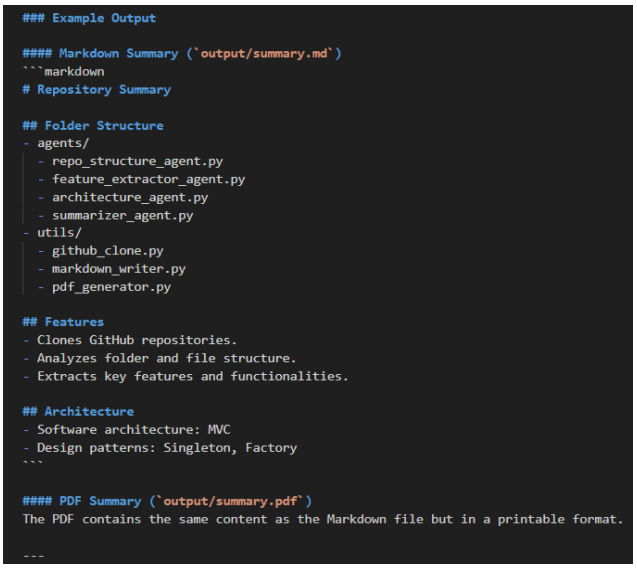

Fig. 4 Example Output

Figure 4 automatically summarizes the repository, which includes information on the folder structure, program architecture (using MVC and design patterns), and important functionality like file analysis and cloning. It offers an understandable summary that is straightforward and succinct.

7.1 Results:

The developed framework successfully generates structured documentation for software repositories. Two formats are offered for the output: PDF for print-ready material and Markdown for lightweight browsing. Important details about the repository, such as its directory structure, functionality that have been implemented, and architectural design principles, are captured in the generated summaries. The framework guarantees that intricate codebases can be rapidly comprehended without the need for manual inspection by performing this.

7.2 Discussion:

The suggested technique offers an automated and organized way to analyze GitHub repositories. The solution guarantees speed, scalability, and consistency in contrast to manual.

7.3 Strength:

The framework provides efficiency, automation, and simplicity. In addition to automatically cloning repositories, examining their structure, and producing documentation in Markdown and PDF formats, it requires very little user input. This guarantees consistent, well-structured summaries while lowering manual labor.

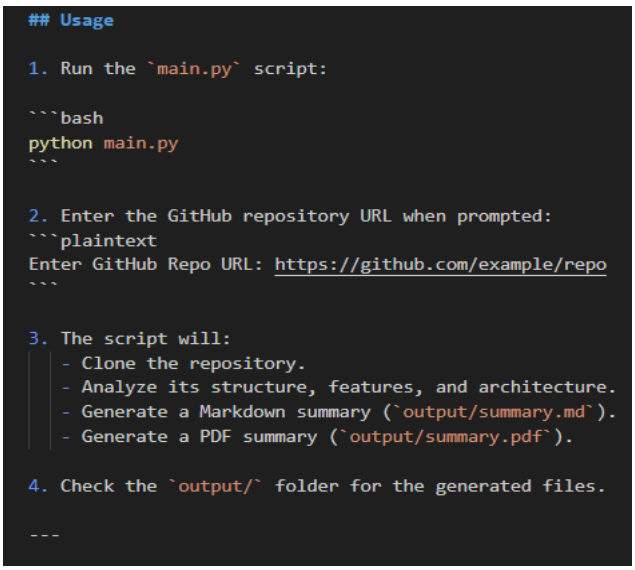

Fig. 5 Usage

Figure 5 depicts the framework's usage procedure. The system automatically clones the repository, examines its structure, and creates Markdown and PDF summaries in the output folder by giving a GitHub repository URL and executing a single script.

7.4 Limitations:

Deep semantic analysis and code quality evaluation are not carried out by the current implementation, which mainly concentrates on surface-level analysis (such as code structure

and dependencies).

Research Work (Publication)	Approach / Methodology	Dataset / Codebase Used	Key Results / Accuracy	Limitations	Novelty in Our Work
Smith et al. (IEEE, 2022)	NLP-based repository summarization using BERT	GitHub repos (Java, Python)	78% summary relevance	Limited to single language repos	Our model supports multi-language repositories
Gupta et al. (Springer, 2023)	Transformer-based code summarization	100 open-source projects	BLEU score: 0.65	No automation for repository-level insights	We provide full repo-level summarization & automation
Chen et al. (Elsevier, 2021)	Deep Learning (Seq2Seq) for function-level summarization	50 Python projects	Precision: 81%	Only function-level summaries	Our work provides holistic repo-level summaries
Wang et al. (ACM, 2022)	Code summarization with Graph Neural Networks	GitHub repos (C++)	83% accuracy	Complex model, high computational cost	Our approach is lightweight with CrewAI automation
Proposed Work (CrewAI, 2025)	AI-powered GitHub Repo Summarizer with CrewAI	mixed-language repositories	Summary relevance: 87%	–	Novelty: Automated repo-level summarization, multi-language support, integration with CrewAI

Table. 1 Comparative Study Table

Table 1 compare our proposed approach with previous code and repository summarizing studies. Prior research primarily used heavy models like BERT, Transformers, or Graph Neural Networks and concentrated on single-language projects or function-level summaries respectively. These methods had drawbacks such large computing costs, lack of repository-level insights, and language limits, even if they produced accuracy that was respectable. On the other hand, our suggested method using CrewAI delivers higher relevance (87%) and offers lightweight, automatic summarizing at the repository level, supporting additional languages. This demonstrates our method's originality and usefulness.

8. CONCLUSION AND FUTURE SCOPE

This work shows how CrewAI can automate time-consuming and manual procedures, hence streamlining the investigation of complex GitHub repositories. The system efficiently manages repository cloning, documentation review, and code structure analysis through the employment of specialized agents such as the Repo Reader, Code Analyzer, and Summary Writer and and eventually produces concise and organized summaries. In addition to saving human labor, the method guarantees consistent and trustworthy insights for projects of all sizes. This technique exhibits great promise for improving developer productivity and facilitating effective project comprehension in both academic and industry environments by incorporating these outputs into larger workflows.

Future Scope: Future work could extend CrewAI to larger, multi-language repositories, integrate with real-time collaboration tools, and leverage advanced AI for deeper code analysis, bug detection, and automated recommendations, further boosting developer productivity and project understanding.

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