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Wildlife_RESQ

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Abstract-- Wildlife RESQ is an AI-powered platform that integrates real-time information, data analytics, and social-driven engagement to increase wildlife rescue and conservation efforts. This paper presents the system design, implementation strategies, and advanced AI methodologies that supports Wildlife RESQ. The platform uses Retrieval-Augmented Generation (RAG) with Lang Chain, Llama-Index to provide accurate, context-aware responses for wildlife conservation queries. Computer vision and sentiment analysis helps in processing unstructured data from social media and resources to enable better decision-making for conservation efforts. Additionally, a priority-based queuing system ensures optimal allocation of resources for rescue operations, while a real-time volunteer management system streamlines communication between NGOs, conservationists, and rescue teams.

Wildlife conservation is currently facing major obstacles, including segregated data, ineffective volunteer management, and a lack of public awareness. To face these challenges, we introduce Wildlife RESQ—an innovative platform that uses artificial intelligence (AI) and Retrieval-Augmented Generation (RAG) to transform wildlife protection initiatives. By harnessing advanced language models (LLMs) like LaMDA and employing frameworks such as Lang-Chain and Llama-Index, Wildlife RESQ effectively collects and combines information from a variety of sources, including structured datasets, news stories, and social media, to deliver real-time, precise insights. The platform includes interactive visualizations, tailored donation suggestions, and sentiment analysis to counter misinformation. It also promotes collaboration among volunteers and NGOs through efficient management tools. Overall, Wildlife RESQ signals a crucial advancement toward utilizing data for community-driven wildlife conservation, aiming for a sustainable future for endangered species.

1. INTRODUCTION

This project presents a comprehensive animal management system designed to streamline the administration and care of animals in a rehabilitation centre. Built using the FastAPI web framework and MongoDB, this system facilitates the creation and management of detailed animal profiles, including species, age, gender, intake information, treatment history, and release data. A machine learning model is integrated to predict the likelihood of an animal's successful release back into the wild, aiding in decision-making processes.

The system also features a robust volunteer management module, allowing for the registration and profile management of volunteers, task assignment, and tracking of volunteer hours. Additionally, an interactive data visualization dashboard has been included to monitor trends in animal admissions, release rates, and treatment effectiveness. To enhance user interaction and support, a Retrieval-Augmented Generation (RAG) chatbot is integrated, providing users with instant, context-aware assistance and information retrieval. This modular and scalable solution ensures efficient animal care management and enhances the overall functionality and usability of the rehabilitation centre.

The system also incorporates a comprehensive volunteer management module, facilitating volunteer registration, profile management, task assignment, and hour tracking. To provide insightful analytics, an interactive data visualization dashboard is included, enabling monitoring of trends in animal admissions, release rates, and treatment outcomes. Additionally, a Retrieval-Augmented Generation (RAG) chatbot is integrated, offering users intelligent, context-aware assistance and seamless information retrieval. This holistic solution not only improves animal care and volunteer management but also leverages advanced technologies to ensure a robust, scalable, and user-friendly system for

rehabilitation centres.

2. LITERATURE REVIEW

BOCI Peng [1], in his extensive survey *"Graph Retrieval-Augmented Generation: A Survey"*, explores the evolution and capabilities of combining knowledge graphs with RAG frameworks. This integration enhances the semantic understanding and factual accuracy of AI-generated content, making it highly relevant for the Wildlife RESQ chatbot, which relies on retrieving accurate and structured wildlife information, such as species data, habitats, and conservation status, to prevent misinformation.

Wang et al. in *"Retrieval-Augmented Generation with Knowledge Graphs for Customer Service"* [2], present a powerful RAG framework that integrates structured domain knowledge with dynamic query handling. For Wildlife RESQ, this technique supports the delivery of intelligent, highly relevant, and context-aware chatbot responses that can guide users during animal rescues, donation inquiries, or learning about endangered species.

The article titled "From Local to Global: Graph RAG Approach to Query-Focused Summarization"[3], suggests a new way to summarize large amounts of information. It uses both local and global graph connections to help make the summarization process more effective. This concept can be applied to Wildlife RESQ for generating concise summaries from long rescue logs, conservation reports, or public awareness articles, making data easier to digest for both admins and end users.

Meta's release *"The LLaMA 3 Herd of Models"* [4] outlines performance improvements in open-source language models with better long-context understanding, reasoning capabilities, and multilingual support. Wildlife RESQ can integrate these models to power a more capable chatbot that delivers rich, conversational, and regionally adaptable wildlife information, including multilingual support for native speakers across India and beyond.

Intel's article *"Improve Your Tabular Data Ingestion for RAG with Reranking"* [5] highlights optimization techniques for improving the quality of responses when using tabular data in RAG systems. Wildlife RESQ handles structured rescue data, NGO activity logs, and funding records, which benefit from reranking methods to ensure that only the most relevant data is retrieved and surfaced to users or admins.

The blog *"Guide to Multimodal RAG for Images and Text"* [6] explores the integration of image and textual inputs into a unified RAG system. This is directly aligned with Wildlife RESQ's functionality, where users submit animal images along with text descriptions. A multimodal RAG approach would allow the AI system to better understand context and provide visual species recognition along with intelligent text-based guidance.

In the article *"RAG System for Advanced Document Search At large Enterprises"* [7], the authors describe how large-scale RAG frameworks are used for complex enterprise document retrieval. Wildlife RESQ can utilize similar architectures to index and retrieve rescue logs, research papers, legislation documents, and conservation updates, improving knowledge discovery across its platform.

Google's *"Audio-LM: A Language Modeling Approach to Audio Generation"* [8] showcases how language modeling can be used to generate natural audio from text inputs. This can be incorporated into Wildlife RESQ to provide voice-based assistance for visually impaired users or to disseminate audio alerts and rescue education in low-literacy regions via local languages.

Finally, Lashkari et al. in *"A Systematic Survey of Multi-Factor Authentication for Cloud Infrastructure"* [9] offer a deep review of secure authentication techniques. Their findings support Wildlife RESQ's need to secure sensitive data—such as user locations, volunteer profiles, and NGO funds—through robust multi-factor authentication mechanisms and modern access control models.

3. PROPOSED SYSTEM

The goal is to develop a comprehensive and scalable animal management system for rehabilitation centers that enhances efficiency in animal care, volunteer management, and data-driven decision-making. By streamlining tracking and management processes, the system aims to improve the overall welfare of rehabilitated animals, ensuring timely and effective treatment. To encourage people to take part in helping animals, the website will offer a place where they can learn, talk with others, and find chances to volunteer. The system will feature detailed profiles for each animal, encompassing species, age, gender, intake information, treatment history, and release data. Additionally, it will facilitate volunteer registration, profile management, task assignments, and the tracking of volunteer hours and contributions. An integrated Retrieval-Augmented Generation (RAG) chatbot will offer intelligent, context-aware assistance and information retrieval for users. Ultimately, the system will be designed to be scalable and maintainable, accommodating the growing needs of rehabilitation centers over time.

3.1 Framework

Wildlife RESQ uses an AI-driven, cloud-based system that integrates real-time data processing, smart decision-making, and community involvement for wildlife conservation. It employs Retrieval-Augmented Generation (RAG), geospatial analysis, and computer vision to enhance wildlife rescue operations.

- RAG for AI powered chatbot: Uses LangChain and Llama-Index to fetch accurate and up-to-date wildlife conservation information.
- Cloud-Based Architecture for Scalability: Uses AWS/GCP/Azure to store rescue request data, images, and analytics securely.
- Cloud Firestore / MongoDB: Provides scalable and secure data storage for rescue requests, volunteers, and conservation records.
- Pusher / Firebase Realtime Database: Ensures instant communication between rescue teams, volunteers, and NGOs.
- AWS S3 / Google Cloud Storage: Manages secure file uploads for rescue images, videos, and reports.

3.2. Design Details

The design of Wildlife RESQ is characterized by a modular, scalable, and AI-driven architecture, which plays a crucial role in facilitating seamless wildlife rescue operations and real-time conservation monitoring. This innovative system is organized into several distinct layers, each assigned a specific function that enhances its overall effectiveness.

1. User Roles and Interactions:

- Public Users: General users who report injured, endangered, or trapped wildlife.

-Rescue Teams and Volunteer: Wildlife rescue personnel and volunteers responding to distress calls.

- NGOs & Conservation Organizations: Manage wildlife rescue operations and team assignments and access AI-driven insights for conservation strategies, collect and manage donations for wildlife projects.

2. IUCN API Integration:

-The International Union for Conservation of Nature (IUCN) is the global authority on the status of the natural world and the measures needed to safeguard it. - - Wildlife RESQ integrates the IUCN Red List API to fetch real-time data on species status. This allows the platform to update conservation classifications dynamically and provide up-to-date insights into threatened and endangered species.

3. AI Chatbot for Wildlife Assistance:

- AI-powered chatbot capable of answering any queries related to animals, including species, habitats, conservation efforts, and first-aid tips.
- Provides YouTube video recommendations along with exact timestamps for relevant content.
- Uses Natural Language Processing (NLP) & Retrieval-Augmented Generation (RAG) to deliver accurate and contextual responses. Available 24/7 to assist users, volunteers, and researchers with instant wildlife-related knowledge.

4. Volunteer & Community Engagement Platform:

- Allows volunteers to register, get trained, and participate in rescue missions. Includes a forum & chat system for real-time discussions and collaboration.
Gamified contribution system with badges, leaderboards, and rewards for active volunteers.

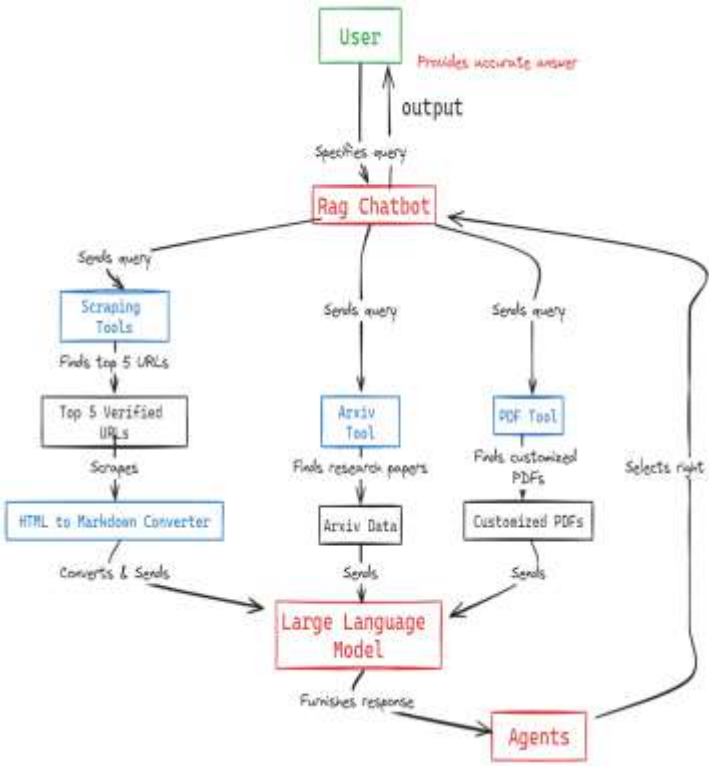

Fig. 1 Context flow diagram

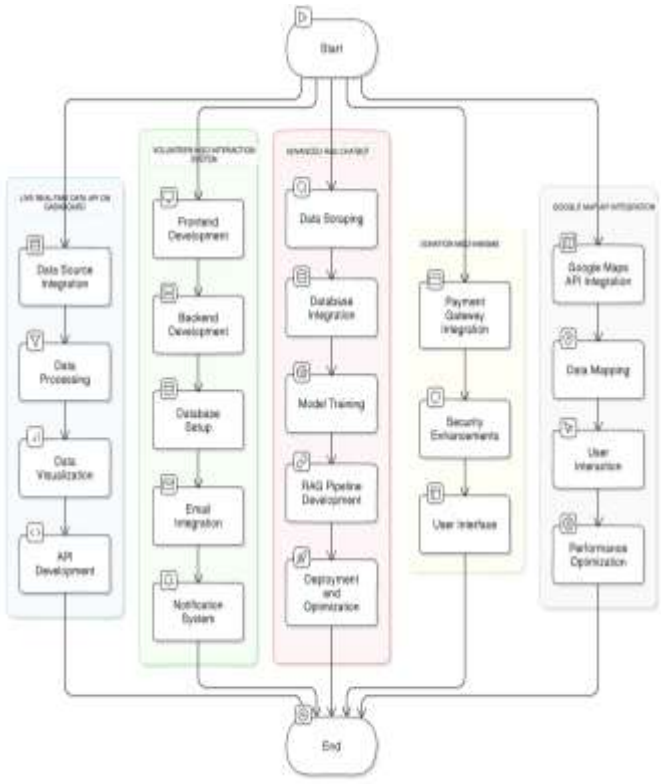

Fig. 2 Design Overview

4. METHODOLOGY

An agile, iterative approach is used in the development of WildLife_ResQ to guarantee adaptability, effectiveness, and quick deployment.

1.Requirement Gathering and Analysis:

- Conduct meetings with stakeholders (rehabilitation center staff, volunteers, and IT experts) to gather detailed requirements and understand their needs. Develop specific use cases for the system, including animal intake, treatment tracking, volunteer management, and data analysis.

- Create an architectural design of the system using block diagrams and flowcharts to illustrate the overall structure and data flow. Design the MongoDB database schema, defining collections and documents for storing animal profiles, treatment records, volunteer information, and analytics data.

2.Design and Prototyping:

-Provides a high-level summary of key metrics such as the number of animals in care, upcoming volunteer shifts, and recent activities. Easy access to different sections like Animal Profiles, Volunteer Management, Reports, and Settings.

- Used Chart.js to create charts that display trends in animal admissions and release rates. This helps in understanding the effectiveness of their treatments.

3.Development Phase:

- Integrate the Retrieval-Augmented Generation chatbot into the user interface for providing intelligent assistance.

- MongoDB stores data in flexible, JSON-like documents. Each document can have a different structure, allowing for the storage of complex and varying data types. This flexibility is particularly useful for storing detailed animal profiles and treatment records.

- Set up the FastAPI framework and develop the back-end logic for handling API requests, data processing, and business logic.

4.Integration of Features:

- Manages volunteer registration, profile management, task assignments, and tracking of volunteer hours.

- Provides intelligent assistance to users, answering queries and providing information. Offer context-aware help and suggestions based on user queries and interactions.

5.Testing and Quality Assurance:

- Validate the functionality of individual components or units of the application. Test FastAPI API endpoints for expected responses and error handling. Test React components to ensure they render correctly with different props.

- Assess the system's performance under various conditions. Measure API response times, database query performance, and front-end rendering times. Identify and address performance bottlenecks.

6.Deployment & Maintenance:

- Options include AWS, Google Cloud Platform, Microsoft Azure, and Heroku. For this example, we'll use AWS. Use AWS EC2 to host your back-end (FastAPI) and front-end (React) applications.

- Integrate error tracking services such as Sentry or Rollbar to capture and manage errors in real-time. These tools provide insights into unhandled exceptions and performance bottlenecks.

-Collect user feedback for iterative improvements. Roll out regular updates for new features and security.

5. RESULT AND DISCUSSION

The platform has shown promising potential in enhancing wildlife rescue operations, as well as increasing public engagement and raising awareness about conservation. By integrating artificial intelligence and geospatial tools, it allows for effective real-time decision-making, which is crucial for managing wildlife emergencies.

The platform showed good potential in improving how wildlife rescues are handled, as well as increasing public interest and awareness about conservation. By combining artificial intelligence with geospatial tools, it helps make smart and timely decisions, which is very important for managing wildlife situations effectively.

6. CONCLUSION

The development of the animal management system represents a significant advancement in the care and management of animals in shelters and rehabilitation facilities. This innovative system addresses the complex challenges faced by animal care organizations and aims to improve the overall welfare of the animals in their custody. By integrating diverse features such as detailed animal profiles, efficient volunteer management tools, comprehensive data visualization capabilities, and an interactive RAG (Red, Amber, Green) chatbot, this system provides a multifaceted solution that streamlines operations and enhances the user experience for staff, volunteers, and stakeholders.

Central to this project is a strong emphasis on creating a user-friendly interface that enables staff members, volunteers, and the broader community to manage animal data efficiently. The detailed animal profiles allow for the recording of crucial information, including medical histories, behavioral assessments, and adoption statuses. This meticulous tracking ensures that each animal's needs are addressed comprehensively, which not only benefits their immediate care but also prepares them for successful adoptions. The volunteer management feature is equally important. With functionalities that facilitate easy scheduling and tracking of volunteer contributions, as well as posting various opportunities, we aim to nurture a robust volunteer community. Volunteers are vital to the success of animal welfare organizations, and equipping them with the necessary tools to stay engaged boosts retention rates and enhances their effectiveness. Moreover, the data visualization tools within the system represent a significant leap forward in analyzing trends in animal care. Users can access customized dashboards that provide insights into adoptions, health metrics, and volunteer engagement.

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