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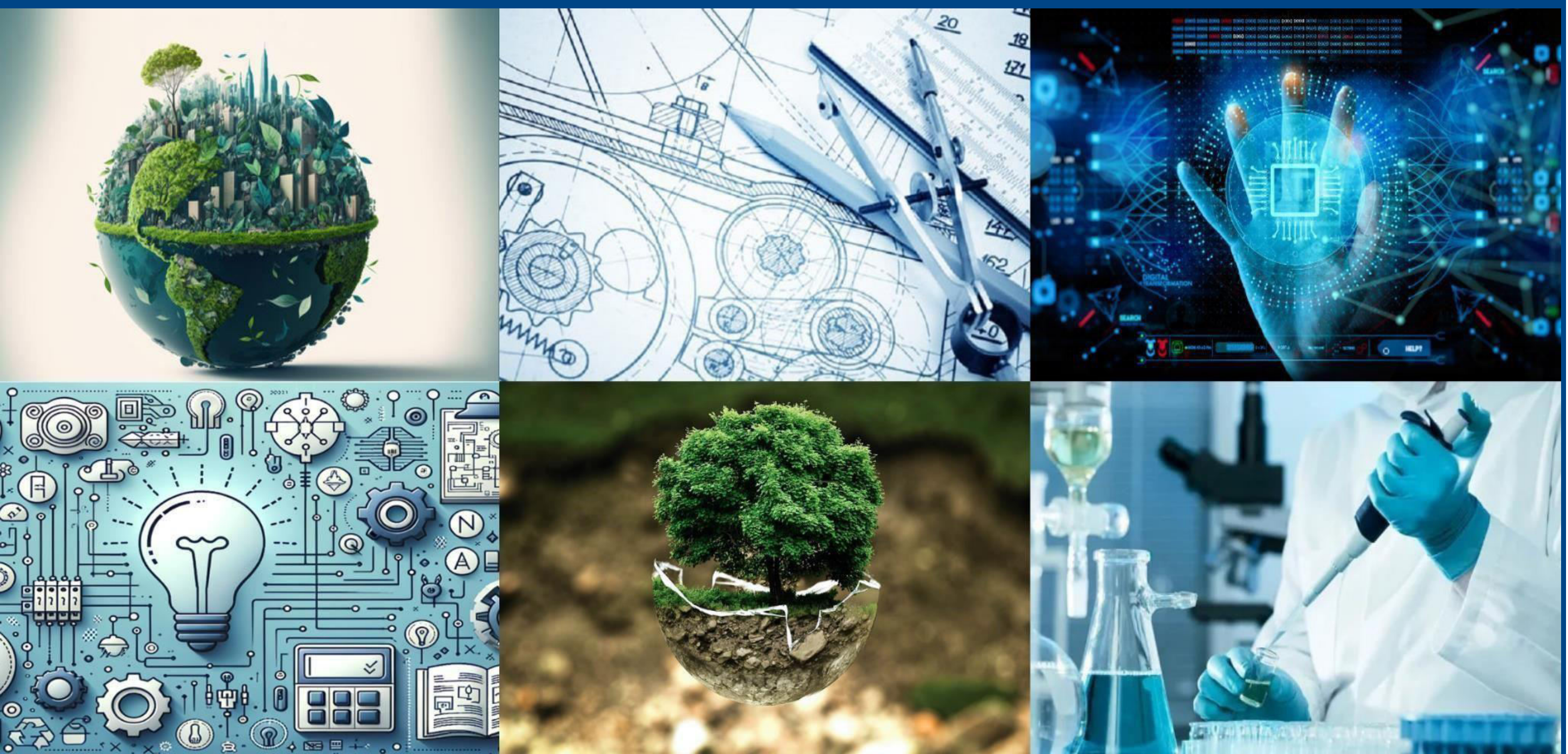

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ROBODOC AI-AI POWERED ROBOTIC SURGERY ASSISTANT FOR DETECTION AND TREATMENT PLANNING

Dr. M S Shashidhara, Divya Shree D

Professor & HOD, Department of MCA, AMC Engineering College, Bengaluru, India

Student, Department of MCA, AMC Engineering College, Bengaluru, India

ABSTRACT: The fast progress in artificial intelligence (AI) and robotics has brought big changes to healthcare, especially in the field of surgery. Traditional surgery, despite significant technological improvements, still faces challenges related to precision, real-time decision-making, and personalization of treatment. To address these issues, this project introduces an AI-Powered Robotic Surgery Assistant that aids in both detection of medical conditions and pre-operative treatment planning, by integrating OpenAI's natural language processing capabilities into a PHP-MySQL based XAMPP environment. This system is designed to assist surgeons by analyzing patient symptoms, interpreting diagnostic data (e.g., reports, scans in text form), and recommending tailored surgical procedures. The platform features an intuitive interface for doctors and patients, a secure local database, and a conversational AI assistant trained to generate relevant surgical guidelines, identify potential complications, and provide post-operative care suggestions.

The project methodology involves building a multi-role web-based system (admin, doctor, patient), training and integrating OpenAI API prompts for contextual understanding of medical scenarios, and structuring the results in a way that can be edited, stored, and reused by the surgeons. The data is stored locally using the XAMPP stack, providing complete control and privacy of sensitive health information.

This system simulates real-time AI-assisted surgery planning support with dynamic feedback mechanisms and feedback-based continuous improvement of AI interactions.

Key findings from the prototype implementation show that the assistant is able to effectively parse complex medical queries, suggest evidence-based treatments, and present surgical pathways that significantly reduce planning time and improve accuracy. The platform also demonstrates potential in enhancing medical education and cross-team collaboration during surgery.

This report details the motivation behind the project, the proposed solution, its scope, system architecture, implementation approach, testing, and anticipated future enhancements. With healthcare increasingly embracing AI, this project aligns with the global shift towards smart, efficient, and patient-centered surgical systems.

I. INTRODUCTION

Surgical procedures are some of the most important and life-saving treatments in the healthcare industry. However, they also carry the highest risk due to the complexity of human anatomy and the need for precision during execution. While roboticassisted surgery has significantly improved surgical accuracy and patient outcomes, it is largely dependent on pre-defined scripts or real-time human control, lacking intelligent decision support.

Artificial Intelligence (AI) has the potential to bridge this gap by enhancing the cognitive capabilities of robotic surgical systems. AI can process vast amounts of data, recognize patterns, and provide intelligent suggestions, which can be particularly beneficial in surgical planning and diagnosis. When integrated into a robotic surgery workflow, AI can assist surgeons in diagnosing patient conditions, selecting appropriate surgical procedures, identifying risks, and planning postoperative care. This project leverages OpenAI's API to bring natural language understanding to the surgical planning environment.

The proposed solution, an **AI-Powered Robotic Surgery Assistant**, is a webbased platform that enables surgeons to interact with an AI engine that can comprehend and respond to medical queries, assist in diagnosis, and provide procedural recommendations. Built on the XAMPP stack (PHP, MySQL, Apache), the system provides a secure and user-friendly interface for both patients and healthcare professionals.

In the current healthcare context, there is a critical need for intelligent systems that not only automate tasks but also enhance decision-making. Especially in resource constrained settings or high-pressure surgical environments, this AI-powered assistant acts as a second opinion and knowledge support tool. It can process clinical notes, interpret findings, and offer up-to-date surgical guidelines drawn from vast medical literature.

As hospitals around the world adopt digital solutions and AI applications in diagnostics, this project addresses the need for a smart, assistive technology that complements the expertise of the surgeon, reduces surgical preparation time, and ultimately improves patient safety and care.

II. LITERATURE SYRVEY

Artificial intelligence (AI) is increasingly influencing modern surgical practices, particularly with the integration of robotic assistance and decision-making tools. Numerous research studies and review papers have explored the applications, limitations, and future scope of AI in robotic surgery. This chapter presents a comprehensive survey of ten recent journal papers that are directly relevant to this project, helping establish a strong foundation for the proposed system.

A recent study by Knudsen et al. (2024) explored various **clinical applications of AI in robotic surgery**, emphasizing how AI can enhance surgical outcomes through real-time video analysis, motion tracking, and task segmentation. The study highlighted intraoperative applications such as force feedback systems, edge detection, and AI-driven assessments of surgeon performance. Ethical considerations, such as accountability in machine-assisted decisions, were also discussed. This aligns closely with the goal of our system, which aims to support real time decision-making during surgical planning and enhance performance evaluation through AI-generated insights (Knudsen et al., 2024).

Byrd IV (2024) conducted a narrative review of AI's role throughout the surgical cycle—from preoperative planning to postoperative care. The paper outlined how AI models are being trained to analyze patient data, recommend surgical approaches, and monitor recovery. The emphasis on natural language interfaces and AI explainability directly supports the conversational AI assistant module in our project. The author also discussed training junior surgeons using AI-generated feedback, a feature that could be adapted into our post-operative guidance system (Byrd, 2024).

Another relevant work titled **"Artificial Intelligence: Revolutionizing Robotic Surgery"** discusses how AI is being applied in robotic systems to improve precision and automation during minimally invasive procedures (MIPS). The authors examined how AI supports suturing, anatomical recognition, and risk detection. The findings showed that AI could reduce surgeon workload and standardize surgical outcomes. However, they also emphasized that such systems must be transparent and easy to interpret. This reinforces our approach to building an interpretable AI system that supports treatment planning using OpenAI APIs without replacing human expertise (Anonymous, 2024).

In a recent paper published in Frontiers in Surgery, the authors explored **current and future applications of AI in surgical decision-making**. They discussed how AI driven systems can simulate patient specific outcomes, prioritize risk factors, and adapt surgical plans based on real-time data. The study especially emphasized the importance of **explainability** in AI systems to ensure surgeons trust the outputs. This directly supports the idea of including a chatbot that not only suggests procedures but also explains why those procedures are appropriate for a given patient case (Frontiers in Surgery, 2024).

A 2023 systematic review by Choi and their colleagues reviewed the use of AI during robotic surgeries. They observed that most AI systems employed in surgeries as of yet are still in development or testing stages, and they are typically endowed with only low to moderate levels of autonomy. However, the review also reported some initial successes, including AI-managed camera control and identification of surgical instruments. These results are useful in knowing what features are feasible to put in our prototype, particularly for instruments utilized prior to surgery rather than directly during the surgery (Choi et al., 2023).

Raza et al. (2024) examined how **language models like ChatGPT** are being used in orthopedic and general surgery settings to assist with clinical summarization, literature reviews, and patient communication. The study highlighted both benefits and risks, including concerns about misinformation and hallucinated citations. This is particularly relevant to our project, which relies on OpenAI API for interpreting input text and generating surgical suggestions. As such, it reinforces the need for rigorous prompt engineering and manual oversight to ensure that the assistant provides accurate and verifiable medical information (Raza et al., 2024).

A study on **virtual assistants in vascular surgery** by Ahmed and Singh (2024) analyzed the effectiveness of AI-powered virtual tools for preoperative planning, intraoperative guidance, and postoperative monitoring. The paper showed that such assistants helped streamline clinical workflows and improved documentation accuracy. However, the authors warned about issues like data quality, lack of standardization, and privacy concerns. These findings support our decision to use a local XAMPP server for secure data management and to restrict access using role-based logins (Ahmed & Singh, 2024).

In a technical review, Kumar et al. (2024) presented an overview of **deep learning models for surgical tool detection** in minimally invasive surgery. The authors compared different convolutional neural network (CNN) architectures and segmentation techniques to identify surgical instruments from laparoscopic videos. The models achieved high accuracy but required large datasets and consistent camera angles. While our project does not currently include video or image recognition, this paper lays the groundwork for potential future modules involving computer vision integration (Kumar et al., 2024).

Yao et al. (2025) explored **embodied intelligence in endovascular robotics**, introducing a data-driven approach that combines reinforcement learning and real time sensory feedback to improve decision making during catheter navigation. The authors emphasized the importance of adaptability and real-time response, which are also central themes in our system's design. Although our assistant currently deals with textual data and symptom-based suggestions, the idea of dynamic learning and adaptability can be applied to improve treatment recommendations over time (Yao et al., 2025).

Lastly, Mansoor and Ibrahim (2025) gave an exhaustive overview of the application of AI in plastic and reconstructive surgery. They discussed how AI assists in outcome prediction, generation of pre-surgical models, and planning microsurgeries. Their research also emphasized the risks of biased algorithms and the necessity for robust rules and guidelines. This implies that for our project, we need to incorporate features that make AI systems transparent, explain the recommendations provided by them in a clear way, and enable the surgeons to modify or override the treatment plans suggested by the AI (Mansoor & Ibrahim, 2025)

III. SYSTEM ARCHITECTURE

System design is the process of defining the architecture, components, data flow, modules, and interfaces of a software application. It serves as a blueprint for developers and stakeholders by clearly outlining how the system will function and interact with users and external services. For this project—an AI-powered assistant for robotic surgery planning—the system design bridges the gap between software requirements and implementation.

The main objective of this system design is to provide a detailed framework that ensures the smooth integration of AI (via OpenAI API), secure patient data management (via MySQL), and an intuitive user interface (via HTML/CSS/JS). The system is designed for hospitals, clinics, and medical institutions that require a supportive tool for surgical diagnosis, treatment suggestion, and decision support, all within a secure and local environment powered by XAMPP.

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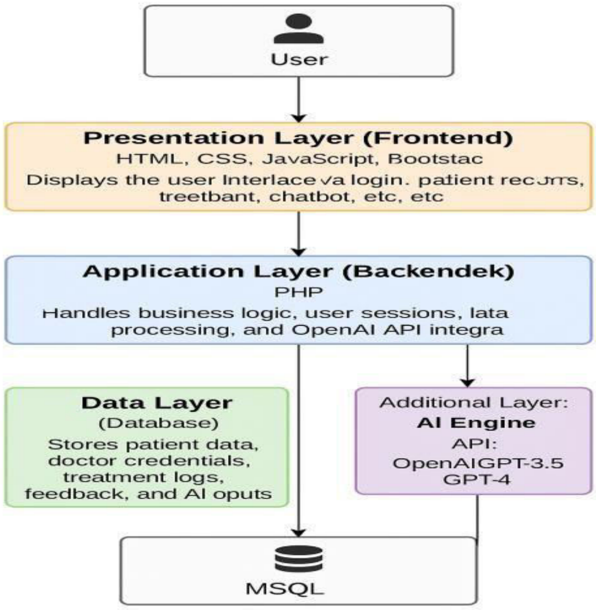

Fig 3.1 System Architecture

IV. METHODOLOGY

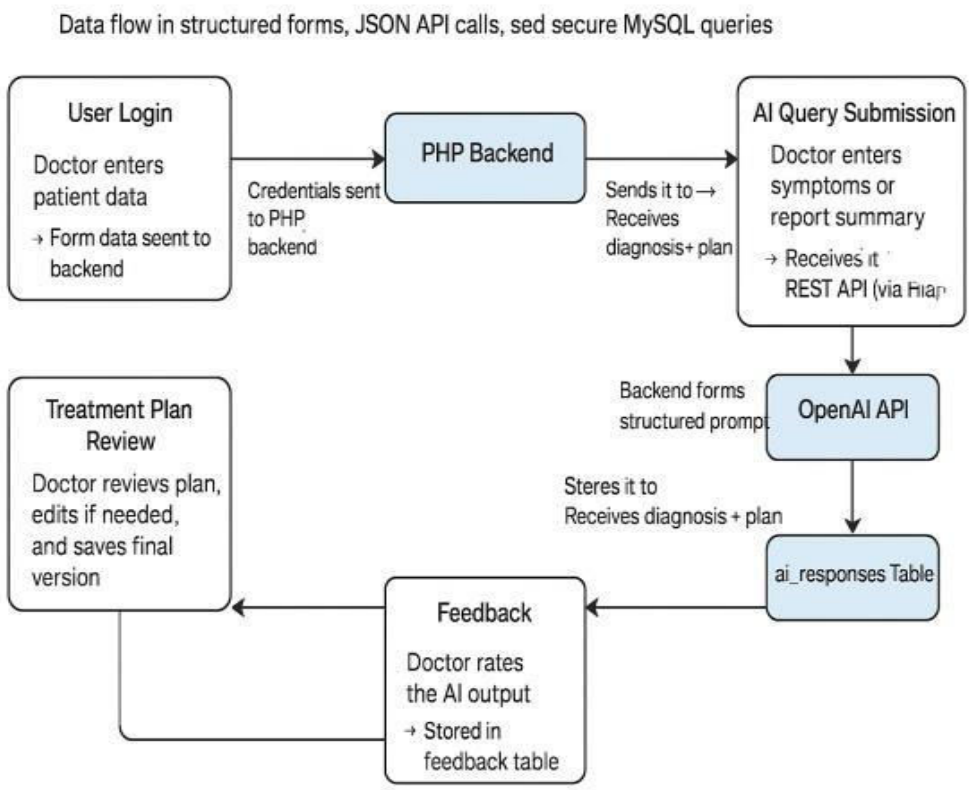

Fig 4.1 Data Flow Diagram

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V. DESIGN AND IMPLEMENTATION

Implementation is the phase where the project transforms from concept and design into a working system. It involves translating the software requirement specification (SRS) and system design into functional modules and integrating them into a complete, deployable application. In this chapter, we explain the approach and structure used to implement the AI Powered Robotic Surgery Assistant, detailing how each component was built, integrated, and tested. Instead of delving into the actual code, the chapter focuses on the **logical flow**, **module architecture**, **technology application**, and **decision making rationale** behind each major functionality.

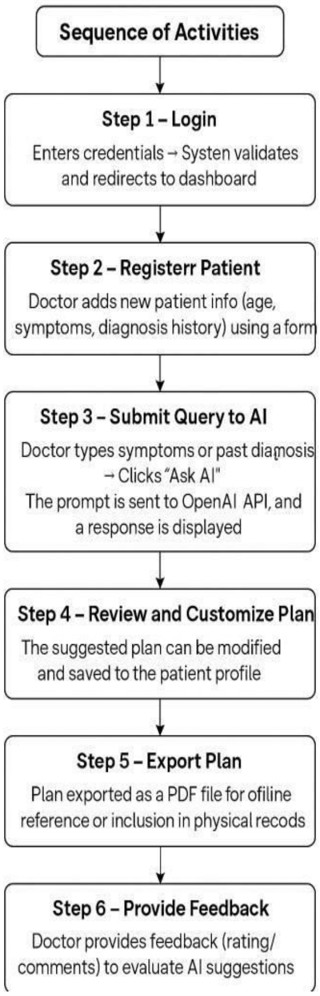

Fig 5.1 Sequential Diagram

AI-built response was given in an organized, easy-tounderstand format. Physicians were able to modify it prior to finalizing the treatment plan. DomPDF
was utilized for export, which converted the plan to a downloadable PDF.

The export format was structured as:

- Diagnosis
- Suggested Procedure
- Post-Op Guidelines
- Doctor's Notes

This was critical for real-world usability and documentation.

VI. OUTCOME OF RESEARCH

Input: "Patient has right lower quadrant pain, nausea, no fever. CT suggests early appendicitis."
AI Response Expected: Diagnosis: Appendicitis. Recommended Treatment: Laparoscopic Appendectomy. Risks: Infection, bleeding.
Actual Result: Matched expectation; clearly segmented and accurate.

VII. CONCLUSION

The project titled **"AI-Powered Robotic Surgery Assistant for Detection and Treatment Planning"** has successfully achieved its intended objectives. It provides a practical, intelligent, and user friendly web-based platform that assists doctors in diagnosing surgical conditions and generating personalized treatment plans using AI. By integrating **OpenAI's GPT API** with **PHP and MySQL**, hosted on a **local XAMPP server**, the system offers both the power of AI and the privacy of localized healthcare environments.

Key outcomes of the project include:
Symptom-based diagnosis support using natural language input.
Surgical treatment planning recommendations, clearly formatted and editable.
The system fills an important gap between AI language models and practical healthcare tools. It demonstrates that with proper prompt engineering and structured workflow, AI can offer valuable assistance to medical professionals—even without requiring large infrastructure or robotics hardware. Furthermore, the modular design ensures that the system is maintainable and scalable for future upgrades.

Through manual testing and usability validation, the system has proven stable, responsive, and accessible. Its flexible design makes it deployable in hospitals, teaching institutions, and even resourceconstrained clinical environments.

VIII. FUTURE ENHANCEMENTS

Although the current system performs its functions effectively, there are several opportunities for enhancement and expansion in future versions:

- Image/Scan Interpretation
- Multilingual Support
- Voice Input and Dictation
- Offline AI Models
- Integration with EHR Systems
- Clinical Decision History Analytics
- Mobile App Interface

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