

**MULTIMEDIA UNIVERSITY OF KENYA**

FACULTY OF COMPUTING & INFORMATION TECHNOLOGY

**AI-Driven Virtual Health Consultant: A Multimodal Interactive Healthcare System.**

BY

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**JANUARY 2025**

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Project Proposal submitted in partial fulfillment of the requirements of Bachelor of Science in Computer/Information Technology

# **DECLARATION**

I hereby declare that this Project Proposal is my own work and has, to the best of my knowledge, not been submitted to any other institution of higher learning.

**Student : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Registration Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Signature: ............................................... Date:.....................................................**

This Project Proposal has been submitted as a partial fulfillment of requirements for the Bachelor of Science in Computer/Information Technology of Multimedia University of Kenya with my approval as the University supervisor.

**Supervisor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Signature: ..................................................... Date: ..................................................**

# **ABSTRACT**

The rise of AI technologies has revolutionized healthcare accessibility. This project proposes a Personal Doctor AI system, a multimodal interactive healthcare assistant, which utilizes text, image, and voice inputs for providing medical insights. Key features include symptom analysis via advanced APIs, real-time language translation, and enhanced video synthesis for personalized healthcare advice. By leveraging OCR for medical prescriptions and dynamic API integration for symptom checking, the system aims to enhance healthcare accessibility globally. The solution ensures inclusivity with multi-language support and robust AI-driven insights. This project employs an agile methodology, combining Python libraries, machine learning models, and medical APIs.

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# **LIST OF ABBREVIATIONS**

**ML-** Machine Learning

**AI -**Artificial Intelligence

**NLP-** Natural Language Proessing

**API -** Application Programming Interface

**$** - Dollar (U.S currency)

**KES**- Kenyan Shillings

# 

# **INTRODUCTION**

## **1.1Background Study**

Healthcare accessibility remains a critical challenge worldwide. With advancements in artificial intelligence, there is an opportunity to bridge gaps in healthcare by developing interactive systems that offer medical insights. This project focuses on creating an AI-Driven Virtual Health Consultant, a system capable of analyzing symptoms, interpreting medical prescriptions, and providing multimodal responses via text, voice, and video.

In Kenya, remote areas such as the North Eastern parts of the country, the health care facilities face a lot of challenges in terms of service delivery due to inadequate staffing and unskilled personnel. But with an AI-Driven Virtual Health Consultant, the people of the region can worry less in terms of access to quality health care as this system offers real-time consultations increasing their access to quality health care.

## **1.2 Problem Statement**

Traditional healthcare systems are often inaccessible to remote areas, linguistically diverse populations, or individuals unable to attend in-person consultations. The lack of accessible, real-time medical insights exacerbates health risks and delays care.

## **1.3 Aim of the study**

This study aims to develop a robust AI-powered system that delivers accurate real-time healthcare assistance through multimodal inputs and outputs such as images, videos and text to easen the burden laid upon our healthcare system.

### **1.3.1 Research Objectives**

* To implement advanced OCR and speech recognition for processing prescriptions and voice inputs.
* To integrate medical APIs like Infermedica for symptom analysis.
* To develop video synthesis capabilities for personalized visual responses.
* To ensure inclusivity through multi-language support in text-to-speech and AI responses.

## **1.4 Significance of the study**

The AI-Driven Virtual Health Consultant aims to reduce the burden on traditional healthcare facilities such as hospitals and clinics by offering real-time healthcare assistance to users thus increasing global access to healthcare which is vital to humanity in general.

## **1.5 Scope**

The system will include:

* Text, image, and voice inputs.
* Outputs in text, voice, and video formats.
* Integration with APIs for symptom checking and language translation.
* OCR for medical document analysis.

## **1.6 Assumptions**

* Users will have access to devices with internet connectivity.
* Medical APIs will provide reliable and updated information.
* Users are computer-literate.

## **1.7 Limitations**

* Dependency on external APIs for symptom analysis.
* Limited to initial prototype capabilities.
* Challenges in understanding highly specialized medical content.
* Dependency on datasets from selected ethnicities and nationalities.

# **Literature Review**

## **2.1 Introduction**

Artificial Intelligence, or AI, in general is a computer's performance of tasks that would otherwise be considered to require human intelligence. Nowadays, hardly any area of science and engineering exists which is not discussing AI. For example, major scientific competitions such as the ImageNet Large Scale Visual Recognition Challenges are providing evidence that computers can achieve human-like competence in image recognition. AI also facilitated major advances in speech recognition and natural language processing. All of these advances raise questions about how such capabilities can support, or even improve, human decision making in health and health care.

Two high-profile research papers in recent years have shown how AI can execute clinical diagnostics from medical images equal to experienced clinicians at least on very specific examples. The promise of AI is directly related with the availability of relevant data. In the health domains, lots of data abound, but most of the existing resources are currently at a low level of quality, and accessibility also remains a very big challenge faced in the country.

On one hand, there is health data with associated privacy concerns with their collection and dissemination, hence particularly cumbersome when compared to most other types of data. Also, health data tends to be really expensive to collect, such as in the cases of longitudinal studies and clinical trials, so when collected, it is closely guarded. Moreover, it prevents even basic computational methods when the electronic health record systems themselves are not interoperable, while the inability of existing systems to capture relevant social and environmental information leaves a set of key variables out of individual health data streams.

Ever since 2022, when ChatGPT was launched, AI gained huge interest among different areas. The expectations from this new topic are really sky-high, above all in health care. The Kenyan government works on the elaboration of regulation, while innovation is already underway.

The market is projected to reach a value of about $ 101.83 million in Kenya, which roughly converts to about KES 11 Billion, by 2030. Indeed, this calls for the development of such solutions for addressing issues like understaffing by medical personnel and overcrowding by patients in hospitals. Sometimes, AI technology can be very incomprehensible, but in actual sense, there lies a solution to real problems within these lines of code.

## 2.2 Related Systems

1. **Babylon Health**

Babylon Health was a digital health service provider that used artificial intelligence (AI) to connect patients with healthcare professionals. The company's goal was to make healthcare more accessible and affordable for everyone.

Babylon Health provided health care services through either its website or iOS and Android mobile applications. This was funded through a subscription-based model, pay-as-you-go payments, centrally funded initiatives like NHS or as part of health insurance packages.

Users could send questions or photos to the company's team of health care professionals (which includes doctors, nurses, and therapists) in a manner similar to a text message. Alternatively, users could hold video messaging consultations with a clinician to answer questions about common medical topics such as fever, sore throat, allergies, skin irritations, and colds. This service also allowed users to receive referrals to health specialists, have drug prescriptions mailed to the user or sent to a pharmacy or to consult with therapists to discuss topics such as depression and anxiety. In situations where a physical examination was required users couuld book health exams with a limited number of facilities in London as well as other locations world wide, and nurse appointments are limited to one location.

Babylon Health operated in countries such as: United kingdom, United States of America (USA), France, Canada among others.

**Services offered**

* **Virtual clinical operations**: Patients could connect with healthcare professionals through the Babylon Health app or website
* **Video doctor appointments**: Patients could have appointments with doctors via video
* **Digital health tools**: Patients could use digital health tools to access healthcare services

**How it worked**

Babylon Health used AI to filter patients so that only those who needed medical attention would be seen.

The company worked with governments, health providers, and insurers to provide healthcare services.

**Awards and recognition**

Babylon Health won awards including:

1. The Financial Times ArcelorMittal Boldness in Business Awards in 2020.

2. The World Government Summit award for Emerging Technology in 2019.

3. RDB's Business Excellence Award for Innovator of the Year in 2019.

4. The IoT AI Breakthrough award for Best AI Solution for Healthcare in 2018.

**What happened to Babylon Health?**

Babylon Health went bankrupt and sold its UK business to eMed.

1. **AntiMicro.Ai**

AntiMicro.ai is a web application powered by artificial intelligence that provides prediction of the antibacterial and antifungal susceptibility. It detects antimicrobial resistance with the help of machine learning models in data analysis. This explanation goes into detail on how it works:

**Data Collection and Preprocessing:**

The application bases its operations on different datasets from sources, which include data on several bacterial and fungal species.

Data preprocessing represents the cleaning and transformation of data to put it into a form that can be used in machine learning. This includes handling missing values, removal of highly collinear variables, and conversion of data into a format compatible with machine learning algorithms2.

**Feature Selection:**

Important features or predictors are identified by using techniques like Shapley additive explanation plots, which becomes important to build any model.

**Model Training:**

A few machine learning models are trained with the help of libraries like NumPy, Pandas, Scikit-learn, and Pycaret. Performance is evaluated by a number of metrics that include AUC, recall, precision, F1 score, Kappa, and the Mathews correlation coefficient.

The best performance, usually seen in decision tree methods like Extreme Gradient Boosting (XGBoost), is selected for deployment.

**Deployment:**

It then gets deployed to the users via a web application developed in Streamlit. Deployment will be done by using GitHub and Streamlit cloud.

On the other hand, a prototype Android app can also be developed using GoNative for providing access to the tool on a mobile platform.

**User Interaction:**

Such a web application allows users to predict both antibacterial and antifungal susceptibility. Clinicians may therefore find it easier to use it to inform treatment decisions while awaiting definitive phenotypic testing.

1. **Infermedica**

Infermedica is the premier digital health company that develops and deploys AI-powered symptom analysis and patient triage solutions. Its mission is to make healthcare accessible, convenient, and affordable for everyone by automating primary care from symptom to outcome.

**How Infermedica Works**

The backbone of Infermedica's technology consists of a sophisticated medical knowledge base, an inference engine, and an API gateway. Here's a breakdown of how the process works:

* **Symptom Input**: The symptom entered by the users comes through several options, like website, mobile, or even on the use of the chatbot-voice or text. Symptoms can be added here in varieties.
* **AI Analysis:** The inference engine, driven by machine learning and natural language processing, analyzes the symptoms provided. The mechanism utilizes a vast knowledge base in medicine, curated by medical experts, to arrive at possible conditions and their likelihood.
* **Triage and Recommendations**: After the analysis, Infermedica returns the triage level by suggesting the degree of care; for example, self-care, primary care physician, emergency room. It might also give some probable conditions, specialist recommendations, and some education.

The API, which they have provided, allows health organizations to integrate their technology into already existing systems and workflows. In this manner, they are able to make the experience as they want it.

**Key Features and Benefits**

1. **Accuracy**: Clinically validated probabilistic models and machine learning algorithms guarantee high accuracy to identify possible causes through Infermedica.
2. **Multi-symptom analysis:** It can analyze a number of symptoms all at once to provide a more holistic analysis.
3. **Multi-lingual:** Infermedica is available in more than 20 languages. This makes it widely accessible.
4. **Customization**: The platform can be configured to meet the needs of various healthcare organizations.
5. **Improves Efficiency**: By automating primary care, Infermedica reduces waiting times, rationalizes resource utilization, and improves patient flow.
6. **Improved Patient Experience:** The platform offers convenience to the patients for access and information and thus guides them in informed decision-making on health matters.

## **2.3 Limitations of these systems**

* **Integration with Clinical Workflows:**

The integration into existing clinical workflows is not going to be straightforward. For their use, the clinicians must feel confident and comprehend the AI predictions, which involves the model transparency and explainability in its decisions.

* **Regulatory and Ethical Considerations:**

There are many regulatory and ethical considerations while implementing AI in clinical practice: protection of patient data, security concerns, and possibilities of algorithmic bias in general.

The resistance patterns of AMR change and fluctuate; thus, models continuously need updating and monitoring to remain relevant.

## **2.4 How the proposed solution will handle these weaknesses**

1. The AI-driven Health care consultant system integrates multimodal inputs and outputs, advanced video synthesis, and multi-language support, addressing gaps in accessibility, usability, and inclusivity.
2. The system will secure database connections to ensure that patient’s data is not accessed by unauthorized personnel and is not tampered with.
3. The system will be built in accordance with the law following all ethical and legal considerations for it.

# **Methodology**

## **3.1 Introduction**

This section presents the process that shall guide the development of the fraud detection system. It outlines the approach and the logic used in the choice of the algorithm and the data set for keeping the system in tandem with the objectives of the project.

## **3.2 Methodology**

Because of the time limit, the Agile development methodology was adopted.

**Reasons**

* **Agility:** Scrum, Kanban. It focuses on the responsiveness of changes. Because of feedback, market requirements, or the shifting need of the business, teams can adapt to project requirement changes and priorities at any instance. Most helpful in dynamic environments where the need could get evolved through time.
* **Iterative Development:** Agile methodologies encourage iterative development in short cycles, releasing workable software quite frequently. During this iterative process, the stakeholders get to see tangible progress quite early and hence can give early feedback, probably leading to the quicker validation of ideas and closer alignment with customer expectations.
* **Continuous Improvement:** Agile frameworks stimulate a culture of continuous improvement. At regular intervals, the teams reflect on how to improve their processes and pinpoint changes that will enhance efficiency and effectiveness. Continuous learning and adaptation emphasize innovation and quality in results.
* **Empowered Teams:** Agile methodologies enable cross-functional teams to self-organize themselves and make most of the decisions by themselves. Team members believe in ownership of the work they are doing. This may increase the motivation, creativity, and accountability of every team member in the team, thus giving them quick responses toward challenges and innovating solutions to those.
* **Early Risk Mitigation**: Agile practices like reviews and retrospectives facilitate the timely identification and mitigation of risks. Thus, by breaking down the work into small, manageable increments and delivering value incrementally, agile teams can spot problems earlier than later and handle them before things get out of hand.
* **Predictable Delivery:** Traditional methods of project management have problems in predicting the time and estimate of a project. Agile methodologies allow for more predictable delivery schedules. Time-boxed iteration and velocity tracking enable teams to predict better the progress of the project and set realistic expectations for stakeholders.

## **3.3 Data sets**

* Symptom and condition data via Medical APIs
* User inputs via simulated datasets

## **3.4 Project Resources**

**Hardware:**

* Laptop/Desktop
* Microphone and Camera for testing multimodal inputs

**Software:**

* Python Libraries: OpenAI, Pytesseract, SpeechRecognition, MoviePy
* External APIs: Infermedica, Google Translate

## **3.5 Project Schedule**

| **Task** | **Duration in weeks** |
| --- | --- |
| Research and planning | 1-2 |
| Development Phase 1 | 3-7 |
| Testing and Integration | 8-9 |
| Final Deployment | 10 |

*Table1.*

## **3.6 Project Budget**

## 

| **Resource** | **Cost (KES)** |
| --- | --- |
| Hardware upgrades | 7,000 |
| API subscriptions | 10,000 |
| Hosting | 2,500 |
| Miscallenous | 2,500 |
| **Total** | **22,000** |

## *Table2.*

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