

**KARATINA UNIVERSITY**

**SCHOOL OF PURE AND APPLIED SCIENCES DEPARTMENT OF COMPUTER SCIENCE AND INFORMATICS**

**AI-powered Virtual Assistant for Business Optimization**

**P101/1726G/21**

Department of Pure and applied sciences project proposal as partial fulfillment of requirements for Bachelor’s Degree in Computer science and informatics.

# 

# Abstract:

The rapid growth of e-commerce and the increasing demand for seamless customer experiences have prompted businesses to seek innovative solutions to manage customer support and optimize operations. This project proposes the development of an Intelligent Business Virtual Assistant powered by Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies, designed to automate and enhance business processes. The virtual assistant will serve as a chatbot capable of managing customer inquiries, processing orders, and providing real-time support on business platforms. By utilizing machine learning algorithms, the chatbot will continuously improve its ability to provide accurate and context-aware responses, ensuring higher customer satisfaction. In addition to handling customer support, the assistant will assist with business operations such as inventory management, appointment scheduling, and performance analysis, thus enabling businesses to streamline their operations and reduce human error. This solution will operate 24/7, providing customers with immediate assistance, reducing the burden on customer support agents, and lowering operational costs. Through this project, businesses can achieve greater efficiency, improved customer experience, and operational scalability, ultimately driving growth and profitability. The chatbot will also be able to escalate more complex issues to human agents when necessary, ensuring that customer concerns are fully addressed.

# **DECLARATION**

I hereby declare that this project report was based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at Karatina University.

Name: \_\_ **Kariuki**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ID No: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**SUPERVISOR**

Date…………………………………………………………………………. Signature……………………..

# ACKNOWLEDGEMENT

# Table of Contents

[Abstract: 2](#_Toc193182243)

[DECLARATION 2](#_Toc193182244)

[ACKNOWLEDGEMENT 3](#_Toc193182245)

[Table of Contents 4](#_Toc193182246)

[Table of Figures 6](#_Toc193182247)

[CHAPTER 1: Background Information 7](#_Toc193182248)

[1.1 Background Information 7](#_Toc193182249)

[1.2 Role of Chatbots in Business Automation 8](#_Toc193182250)

[1.3.Problem statement 8](#_Toc193182251)

[1.4 Objectives of the study 8](#_Toc193182252)

[1.4.1 General Objective 8](#_Toc193182253)

[1.4.2 Specific Objectives 8](#_Toc193182254)

[1.5 Scope and boundary 9](#_Toc193182255)

[1.6 Justification 9](#_Toc193182256)

[CHAPTER TWO: Literature review 9](#_Toc193182257)

[2.1 What are Chatbots and how do they work? 9](#_Toc193182258)

[2.2 Current Use Cases and Applications of Chatbots in Business optimization 11](#_Toc193182259)

[2.3 How do Chatbots process human languages? 13](#_Toc193182260)

[Core Structure of an AI-Powered Virtual Assistant 15](#_Toc193182261)

[CHAPTER 3: Methodology 21](#_Toc193182262)

[3.1 System Development Methodology 21](#_Toc193182263)

[3.1.1 Agile methodology 21](#_Toc193182264)

[Proposed solution and anticipated results 25](#_Toc193182265)

[3.3 Schedule of Activities and Gantt Chart 26](#_Toc193182266)

[APPENDICES 28](#_Toc193182267)

[Appendix I: TIME SCHEDULE 28](#_Toc193182268)

[Appendix II: BUDGET 29](#_Toc193182269)

[References 31](#_Toc193182270)

# Table of Figures

[Fig 1 13](#_Toc193179521)

[Fig 2 23](#_Toc193179522)

[Tab 1 29](#_Toc193179523)

[Tab 2 30](file:///C:\Users\karis\Downloads\omondi%201.docx#_Toc193179524)

## CHAPTER 1: Background Information

## 1.1 Background Information

Businesses in a variety of sectors are rapidly using artificial intelligence (AI) in the current business environment to increase operational efficiency, enhance customer satisfaction, and streamline processes. Chatbot use is one of the most significant uses of AI in business. Businesses may automate client interactions, respond to inquiries, and even carry out business tasks like lead generation, inventory management, and sales assistance with chatbots—AI-powered systems that are made to engage with customers in a conversational fashion.  
  
Businesses are using chatbots to do repetitive jobs as a result of the explosive expansion of online commerce and the growing need for immediate replies from consumers. The capacity of chatbots to function around-the-clock, guaranteeing that clients may obtain assistance and services whenever they need them, is a major factor in their uptake. Additionally, machine learning (ML) algorithms fuel chatbots, allowing them to learn and refine their responses based on user interactions, so boosting their efficacy over time.

Chatbots are frequently incorporated into websites, mobile applications, and social media platforms in business settings so they may offer immediate and individualized client service. Chatbots, for instance, are used by e-commerce platforms to help customers with product inquiries, monitor the status of orders, and even streamline the purchasing process. In addition to providing customer assistance, chatbots are used to do company tasks including order processing, inventory management, and even meeting scheduling. This gives companies a means to lower operating expenses, cut down on human error, and offer smooth customer service.  
  
Notwithstanding its benefits, companies still have difficulties when creating and using chatbots, especially when it comes to comprehending natural language and preserving context across exchanges. Chatbots frequently require ongoing training to enhance their conversational skills, which necessitates a large time and resource commitment. Furthermore, creating complex chatbots requires knowledge in software engineering, machine learning, and natural language processing (NLP).

This project seeks to explore the design and development of a Business Chatbot, specifically focusing on the integration of AI technologies to manage business operations such as inventory management, customer service automation, and sales support. By leveraging advanced machine learning techniques, the proposed chatbot will enhance business performance, improve decision-making, and reduce operational inefficiencies.

## 1.2 Role of Chatbots in Business Automation

Automating customer service is one of chatbots' main functions in business. Chatbots ease the burden on human agents by answering frequently asked questions and offering prompt answers, which speeds up response times and lowers operating expenses.

Chatbots have been effectively used by e-commerce giants like Amazon and Alibaba to help customers with order tracking, returns, and general inquiries. In addition to providing answers, these bots handle basic problems like account management and password resets without the need for human assistance.

Chatbots improve operational efficiency and streamline consumer interactions, chatbots are revolutionizing business automations. Chatbots are designed to answer routine questions, respond instantly, and offer round-the-clock availability in customer care, greatly lessening the workload for human agents. They lower costs by allowing companies to expand their support systems without having to hire as many employees. Chatbots can comprehend and reply to a variety of consumer inquiries by utilizing machine learning (ML) and natural language processing (NLP) algorithms, which enhances user engagement. By engaging with potential clients and assisting them along the sales funnel, chatbots also help with lead creation, qualification, and nurturing in sales and marketing automation. Increased conversion rates and customer satisfaction are frequently the results of this proactive engagement.

## 1.3.Problem statement

Businesses are under more and more pressure to increase operational efficiency, improve customer service, and save costs in the fast-paced, fiercely competitive corporate world of today. Conventional approaches to business operations and customer care are frequently time-consuming and prone to human mistake, which causes delays, inefficiencies, and a less-than-ideal customer experience. Meeting client expectations without drastically raising operating costs has become challenging for organizations due to the demand for real-time contact and round-the-clock availability. Many companies still find it difficult to incorporate efficient systems that can respond to consumer questions, control inventory, and facilitate internal operations. Chatbots are one important area where automation can lead to notable advancements. However, a lot of companies lack the know-how or resources necessary to deploy intelligent chatbot systems that can automate processes like sales, inventory control, and customer support while offering tailored, context-aware interactions.

## 1.4 Objectives of the study

### 1.4.1 General Objective

This study's main goal is to create a chatbot system driven by AI that can increase operational efficiency, automate important business procedures, and improve customer service interactions. Natural language processing (NLP) and machine learning (ML) technology will be used by this chatbot to manage inventory, respond to real-time customer requests, and expedite internal business processes.

### 1.4.2 Specific Objectives

1. To create and put into use a chatbot system that can automate customer support tasks like responding to product inquiries, answering often asked questions, and making tailored recommendations.
2. To integrate the chatbot with an inventory management system, allowing the chatbot to monitor stock levels, suggest restocking, and help with order processing to ensure efficient business operations.
3. To use machine learning algorithms to improve the chatbot’s performance over time by analyzing user interactions, predicting user intent, and adapting responses based on historical data and feedback.

## **1.5 Scope and boundary**

* This project focuses on the development of an AI-powered chatbot system tailored for business automation, with an emphasis on customer service, inventory management, and operational support. The chatbot will be designed to handle a variety of business processes, including responding to customer queries, assisting with sales inquiries, and managing stock levels in real-time. The scope of the project will cover the integration of Natural Language Processing (NLP) and Machine Learning (ML) technologies to create a chatbot that is capable of learning from user interactions and adapting over time.
* This project focuses on the development of an AI-powered chatbot system tailored for business automation, with an emphasis on customer service, inventory management, and operational support

## 1.6 Justification

1. Businesses are constantly under pressure to streamline processes, provide outstanding customer service, and cut expenses without sacrificing or lowering service quality in today's fast-paced, data-driven environment. Manually managing repetitive processes like order processing, inventory control, and customer questions can be resource-intensive, time-consuming, and prone to human mistake. An AI-powered chatbot can be quite helpful in this situation.
2. The introduction of an intelligent chatbot system into business operations brings several benefits, beginning with enhanced customer engagement. Customers increasingly demand faster response times and 24/7 availability, and this system will address these needs by providing instant and accurate responses to customer inquiries, regardless of time or volume .

## 2.3 How do Chatbots process human languages?

A chatbot may initially appear to be an ordinary cloud application. A database, an application layer, and APIs for contacting outside services are all present. In this instance, a chat interface takes the place of UI (Techlabs M., 2017). The bot's ability to comprehend the customer's intent is a common concern. First, real data is used to train the bots. Developers use a combination of machine learning models and tools to match customer questions with the best possible response (Techlabs M., 2017).

Through a mix of Natural Language Processing (NLP) tools, chatbots are able to comprehend, interpret, and provide responses that are similar to those of a human. The user inputs speech or text at the start of the process, which is subsequently divided into smaller units such as words, phrases, or sentences. Tokenization is the process by which the system divides the language into digestible parts. The chatbot use syntactic analysis to comprehend the sentence's grammar and structure after the input has been tokenized. This aids the system in identifying word associations and deriving meaning. Semantic analysis may also be used by the chatbot to determine the purpose of the user's input, such as whether they are requesting information, making a purchase, or asking for assistance.

#### How does the Chatbot learn after it is live?

After going live, a chatbot uses a variety of techniques to keep learning and getting better over time. How it learns is as follows:  
  
1. Constant User Interaction: The chatbot gathers information from users' queries, requests, and comments as they engage with it. Understanding user inquiries and the effectiveness of the chatbot's responses can be gained from this data. The chatbot's ability to anticipate user intent and comprehend linguistic nuances improves with the number of interactions it has.   
  
2. Feedback Loops: A lot of chatbots include features that allow users to flag wrong answers, evaluate responses, and offer feedback. The chatbot uses this feedback as a guide to identify areas for improvement as it learns. This can be automated or manual, with engineers reviewing user comments.

3. Machine Learning and Training: By examining conversational patterns, chatbots that employ machine learning (ML) models—such as supervised learning—can get better over time. Using new data from real-world encounters, developers can retrain the chatbot's algorithms on a regular basis. This enables the chatbot to adjust to changing user behavior, language, and emerging trends.

4. Knowledge Base Updating: A chatbot that is connected to a database or knowledge base can update its responses by adding new data or changing preexisting data. Developers can accomplish this manually by adding content to increase the bot's expertise or by using automated procedures.  
  
5. Contextual Learning: Some chatbots can remember user interactions over time, which allows them to personalize responses and offer more relevant suggestions. They use context to adjust their answers based on what was discussed earlier in the conversation, further enhancing their accuracy and relevance..

What technologies are behind Chatbots?

Chatbots are powered by several key technologies that enable them to understand and respond to human language. One of the fundamental technologies is Natural Language Processing (NLP), which allows chatbots to interpret and process human language in a way that is meaningful. NLP involves various techniques such as tokenization (breaking down text into smaller units like words or phrases), named entity recognition (identifying key components like names or dates), and part-of-speech tagging (understanding the grammatical structure of a sentence). Machine learning (ML) algorithms are also integral to chatbot development, enabling the bot to learn from data and improve over time. With ML, chatbots can recognize patterns in user input and make more accurate predictions about the user's intent. As a result, the chatbot becomes more efficient and adaptable, providing increasingly accurate and relevant responses.

Chatbots use Artificial Intelligence (AI) technologies like deep learning, which simulate more intricate relationships between language and context, in addition to natural language processing (NLP) and machine learning (ML). Chatbots with artificial intelligence (AI), particularly those that use neural networks, may comprehend more complex language and have longer, more engaging conversations. In order to extend their operations and guarantee that they can manage large volumes of user interactions concurrently, chatbots are frequently coupled with cloud computing systems. By providing real-time updates, ongoing learning, and access to large datasets, this cloud architecture enhances the chatbot's capacity to provide consumers with accurate responses across a range of disciplines. When combined, these technologies give users interacting with chatbots a smooth and effective experience.   
  
(Sources: Kumar, 2020; TechCrunch, 2021).

#### 

An **AI-powered Virtual Assistant** for business optimization follows a structured framework that integrates **Artificial Intelligence (AI), Machine Learning (ML), Natural Language Processing (NLP), and Automation** to improve efficiency, customer interactions, and decision-making.

### ****Core Structure of an AI-Powered Virtual Assistant****

1. Interaction Layer & User Interface (UI) This is how people communicate with the assistant using graphical user interfaces, voice commands, or text messages.  
    Channels: voice assistants (Alexa, Google Assistant), mobile apps, messaging apps (WhatsApp, Messenger), and online chat.  
    Input Methods: Voice commands, text-based conversation, and multimodal interactions (pictures, videos).
2. NLP Engine for Natural Language Processing transforms user input into structured information that artificial intelligence can understand.  
   Text processing includes entity recognition (e.g., identifying "refund" as a financial phrase), tokenization, and part-of-speech tagging.  
    Speech Recognition: Automatic Speech Recognition (ASR) transforms voice into text.  
   As an example, "track my order" → intent: order tracking. Intent Recognition: identifies the user's desire.  
    Context Management: Keeps track of previous conversations to deliver pertinent answers.
3. Machine Learning & AI Decision Engine Analyzes user inquiries and produces intelligent answers using AI models.

Intent Mapping & Prediction: By analyzing previous interactions, machine learning algorithms forecast the user's demands.  
 Suggestion System: Tailored recommendations for goods or services.  
 Sentiment analysis: identifies feelings (such as annoyance or contentment) to modify reactions.  
 Adaptive Learning: By learning from previous interactions, the assistant gets better with time.

1. Data sources & knowledge base  
   Information is retrieved by the assistant from company databases and frequently asked questions.  
   Static Knowledge: Pre-written answers to support and frequently asked questions.  
    Dynamic Knowledge: Real-time information from APIs, CRM, and ERP (e.g., order tracking, inventory adjustments).  
   Connectivity to Business Systems: connects to payment gateways, HRMS, ERP, and CRM (Salesforce, HubSpot).
2. Action execution and automation Layer completes things on its own without assistance from humans.

Pattern Matchers

Pattern matching is an important concept within the broader field of Natural Language Processing (NLP), and it plays a key role in how chatbots understand and process human language.

A simple pattern matching example:

```python

import re

user\_input = "I want to know the price of the red sneakers."

Predefined patterns

patterns = [

r"I want to know the price of (+ +)", # Pattern to match product name with two words

r"What is the cost of (+ +)", # Pattern for cost inquiries

]

Check patterns

for pattern in patterns:

match = re.search(pattern, user\_input.lower())

if match:

product = match.group(1) # Extract matched product (e.g., "red sneakers")

print(f"Chatbot response: 'The product are priced at50. Would you like to add them to your cart?'")

break

else:

print("Chatbot: Sorry, I didn't understand your request.")

Output:

Chatbot response: 'The red sneakers are priced at $50. Would you like to add them to your cart?'

```

The Chatbot can also respond to anything relating to it in the associated pattern (Techlabs M. , 2017).

Algorithms

The proposed chatbot system for business inventory management relies on Natural Language Processing (NLP) and machine learning algorithms to process and respond to user queries. The process begins with the chatbot receiving and analyzing the user's input. It uses pattern matching to identify specific keywords or patterns in the query (e.g., product name, price, size), extracting relevant information. For example, if the user asks, "What is the price of a blue jacket?" the system recognizes "price" and "blue jacket" as key components, enabling the chatbot to retrieve the current price from the inventory database. Technologies like spaCy and NLTK can be utilized for NLP tasks to improve language understanding and contextual interpretation (Chowdhury, 2003).

Once the chatbot retrieves the relevant data, it generates an appropriate response, such as "The price of the blue jacket is $50." If the chatbot cannot find the requested information, it will provide a fallback response like, "Sorry, I couldn't find that information." The system continuously learns from user interactions, improving over time through machine learning techniques. By collecting data on user behavior and satisfaction, the chatbot adapts its responses, using supervised learning or reinforcement learning methods to enhance performance (Goodfellow et al., 2016). This allows the system to refine its ability to understand and respond accurately to new queries, ensuring ongoing improvement in business automation.

Through this process, the chatbot not only functions as an interactive interface but also learns from each interaction, which aids in enhancing customer experience and operational efficiency. The integration of machine learning and NLP ensures the chatbot’s adaptability, making it a powerful tool for businesses looking to automate inventory management and customer support tasks effectively.

Sample training set:

*class: greeting*

” How are you today?”

“Good morning, what do you have in stock?”

” I’m doing great, thank you for asking! How can I assist you today?”

” Good morning! We have the following products in stock: shoes, shirts, and jackets.”

Greeting (score=1), Product Inquiry (score=1)

” Can I get shoes in size 8 ?”

“Sure, we have shoes available in size 8. Let me show you the options”.

Product Availability Inquiry (score=2)

**Example**: Sentence Classification

Input: “Hello good morning”

1. Term: “Hello”

No matches

Classification: Greeting

2. Term: “Good”

Class: Greeting

Classification: Greeting

3. Term: “Morning”

Class: Greeting

Classification: Greeting

Classification Result: Greeting (score=3)

Word matches are found per each class's provided sample sentences using an equation. Although the classification score shows which class has the most term matches, it has certain drawbacks. Although it does not ensure a perfect match, the score indicates which intent is more likely to be present in the text (Techlabs M., 2017). Only the relativity base is provided by the highest score.

###### class: greeting “How you doing?” “good morning” “hi there”

(Techlabs M. , 2017)

Sample sentence classification:

###### Input: “Hello good morning” Term: “hello” (no matches) Term: “good” (class: greeting)

***Term: “morning” (class: greeting”***

(Techlabs M. , 2017)

NLU (Natural Language Understanding)

This has 3 specific concepts:

1. **Entities** – this illustrates a notion in your chatbot. It might be an e-commerce chatbot's payment mechanism (Techlabs M., 2017).
2. **Intents -** Basically, it is what the chatbot should do when the user says something. For example, if the user types "I want to order a red air of shoes," "Do you have red shoes? I want to order them," or "Show me some red pairs of shoes," all of these user-generated texts will trigger a single command that will give the user options for a red pair of shoes (Techlabs M., 2017).
3. **Context** – According to Techlabs (2017), an NLU algorithm does not have the history of the user conversation when it analyzes a sentence, so if it receives the answer to a question it just asked, it will not remember the question. The state of the chat conversation should be stored in order to distinguish between different phases.

(NLP) Natural Language Processing

(Varone, 2016) is an NLP A chatbot that uses a series of actions to transform the user's speech or text into structured data that may be used to choose the appropriate response. Here are a few of the steps:

* 1. Tokenization: Tokenization is an essential first step in processing user input. To do this, a sentence or input text is divided into smaller, easier-to-manage components known as tokens (e.g., words, phrases, or even punctuation marks). The basis for additional analysis is tokenization. The following tokens would be used to deconstruct the statement "Show me shoes in size 10": "Show," "me," "shoes," "in," "size," and "10." The chatbot can evaluate each token separately and comprehend how they relate to one another within the sentence's context by breaking the input up into discrete tokens. In many NLP systems, tokenization is a necessary first step (Techlabs M., 2017).
  2. Normalization: To guarantee consistency and uniformity in the text, the chatbot uses normalization techniques after tokenization. Lemmatization or stemming, which reduces words to their root forms, is usually involved. For instance, "buy" would become the standard word for both "buying" and "bought." In order to prevent needless variances, normalization also entails duties like converting text to lowercase and eliminating punctuation (Joulin et al., 2017). Regardless of minor changes in wording or phrasing, this stage guarantees that the chatbot can more accurately match user inquiries. Normalization improves the chatbot's capacity to match keywords in various settings and streamlines the analysis process.
  3. Sentiment Analysis: An intelligent chatbot's capacity to discern the tone of user input is one of its most crucial characteristics. Assessing the text's emotional tone—whether it conveys positivity, negativity, neutrality, or other emotions—is a key component of sentiment analysis (Liu, 2012). Understanding a message's sentiment allows the chatbot to adjust its responses to the user's feelings, making the exchange more sympathetic and interesting. Sentiment analysis enables the chatbot to identify negative sentiment, such as "I am frustrated with my order," and react appropriately by offering solutions or an apology. By tailoring the interaction, sentiment analysis also helps to enhance the user experience.

# CHAPTER 3: Methodology

## 3.1 System Development Methodology

System development methodology refers to the framework that is used to plan, manage, and control the process of developing an information system.

### 3.1.1 Agile methodology

1. The proposed system will be developed using the agile methodology. Agile Methodology is the most suitable approach due to its iterative, flexible, and collaborative nature (Beck et al., 2001). Agile allows for continuous refinement and improvement, which is crucial in incorporating natural language processing (NLP) and machine learning (ML) technologies (Sommerville, 2011).
2. Through constant collaboration between developers, business stakeholders, and end-users, the project can maintain alignment with the organization's goals while also integrating user feedback efficiently (Schwaber & Beedle, 2002)
3. Agile's flexibility in responding to shifting needs and technological advancements aids in the growth of the chatbot by offering a framework for ongoing improvements and producing measurable outcomes at the end of each sprint. This approach not only guarantees a product that adapts to the changing needs of the company, but it also makes it possible to launch and test new features more quickly.



Fig 2

#### **Analysis and design tools**

#### The tools used in this project are divided into different categories: chatbot development frameworks, machine learning algorithms, natural language processing (NLP) libraries, and design methodologies.

#### To create the chatbot's core functionality, we will use frameworks like Dialogflow (by Google), Microsoft Bot Framework, or Rasa. These platforms allow for the design of conversational models, integration with APIs, and the ability to deploy the chatbot on various messaging platforms like websites, WhatsApp, or even custom mobile apps (Google Cloud, 2020).

#### Machine learning models such as Decision Trees, Random Forests, or Support Vector Machines (SVM) will be employed for intent classification, allowing the chatbot to recognize user queries and respond with the appropriate actions (Hastie et al., 2009). K-nearest neighbors (KNN) is considered for text classification and recommendation tasks.

#### For processing human language, we will use spaCy, NLTK (Natural Language Toolkit), and TensorFlow for training language models that handle tokenization, named entity recognition (NER), and sentiment analysis (Bird et al., 2009). These tools help the chatbot understand context, intent, and user queries in a more nuanced manner.

.

#### **System Implementation Tools**

The tools involve both the hardware and software tools that the system would operate on. The users will be required to have internet connection in order to access the system.

* + 1. Hardware requirement
       1. At least a 2GB RAM,
       2. At least 2.0GHz processor speed
       3. 256 GB Hard disks
       4. Keyboard, mouse and screen
    2. System requirement
       1. Operating System - Windows 7,8,10 and Linux platforms
       2. Database – MySQL
       3. Programming Languages – JavaScript, python
       4. Web Server – NodeJS

#### **System testing and validation**

These are the methods employed during the system's development. These processes ensure that the system works as expected, meets all the specified requirements, and performs effectively in real-world conditions. Testing and validation also help identify any defects or weaknesses in the system, allowing for necessary improvements before deployment.

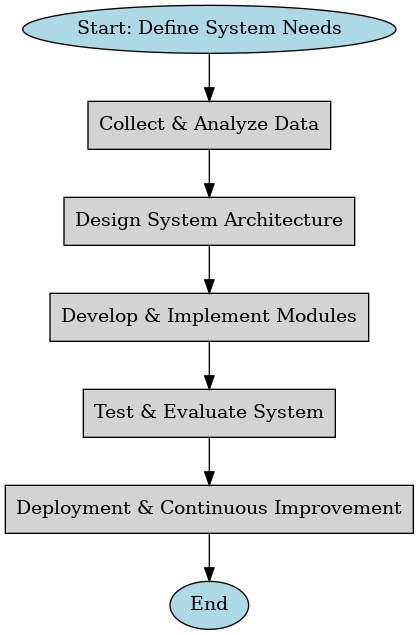
* + 1. Functional Testing - This focuses on verifying that the system’s individual components function appropriately. This involves testing the chatbot’s responses, its ability to recognize user intents, and its capacity to retrieve and process relevant data.

.

* + 1. Performance Testing - This evaluates how well the system performs under different conditions, ensuring that it can handle expected user loads and interactions efficiently.
    2. User Acceptance Testing (UAT) - UAT is an essential part of the testing process, where actual end-users test the chatbot to validate whether it meets their expectations and works in real-world scenarios

Agile encourages constant feedback from both developers and users. During user acceptance testing (UAT), real end-users will provide feedback on the chatbot’s interactions and functionalities. The feedback is collected after each sprint, ensuring that the product is shaped according to the user’s evolving needs. Automated tests can also be integrated to ensure that after each update or change, the chatbot's core functionalities, such as user interaction, intent recognition, and response generation, remain intact.

Agile methodology project development lifecycle

fig 4

## **Proposed solution and anticipated results**

The proposed solution for this project is to develop an AI-based chatbot system designed specifically for business automation, focusing on enhancing customer service, sales, and product management. This chatbot will utilize Natural Language Processing (NLP) techniques to enable it to understand, interpret, and respond to customer queries in a conversational manner, making it a Virtual Business Assistant. The chatbot will be capable of answering customer questions about products, checking availability, processing orders, providing personalized recommendations, and even handling payments via external APIs (such as payment gateways).

The chatbot will be integrated into the business’s existing enterprise systems such as inventory management, CRM systems, and payment gateways to streamline business operations. For instance, it will interact with the Inventory System API to check stock availability in real-time, utilize the CRM System API to offer personalized recommendations based on past purchases, and rely on a Payment Gateway API for processing transactions. These integrations will allow the chatbot to perform a variety of functions in a seamless manner, providing customers with quick and efficient service.

The system will need access to the business’s inventory database for real-time responses on products. This includes integrating with existing Enterprise Resource Planning (ERP) systems that manage product data. On the technological side, the chatbot must leverage Natural Language Processing (NLP) tools like spaCy or Dialogflow to understand and interpret user inputs. Machine learning models will be employed to enhance the chatbot's capabilities, enabling it to continuously learn and improve its responses over time, thus adapting to user preferences and behavior. Through these requirements, the system aims to build a robust, secure, and high-performance chatbot for business automation.

Results of the project are:

1. Improved Customer Interaction: Customers will experience faster, more personalized interactions, improving customer satisfaction.
2. Reduced Operational Costs: By automating routine tasks such as order processing, inventory checking, and customer queries, businesses can save time and reduce costs associated with human labor.
3. Enhanced Efficiency: The AI chatbot will help businesses respond to a higher volume of inquiries, offering immediate responses, 24/7, without the limitations of human availability.
4. Scalable Solution: The system will be scalable, meaning it can be expanded as the business grows without major restructuring.
5. Data Insights and Analytics: By interacting with customers, the chatbot can gather data and insights, allowing businesses to analyze customer preferences, purchase behavior, and product trends.

Thorough testing will be used to assess the efficacy of the suggested solution, making sure the chatbot responds with precise, beneficial information and works well with third-party systems like payment gateways and inventory management. Additionally, the system's scalability and capacity to manage several concurrent interactions will be confirmed. Both qualitative and quantitative gains in customer service, operational effectiveness, and overall corporate success are among the expected outcomes.

## 3.3 **Schedule of Activities and Gantt Chart**

#### The project will be executed in several phases, and each phase will be carefully planned and executed. A Gantt chart will be used to track progress and ensure deadlines are met.

#### Below is a proposed schedule for the project:

* Collecting Requirements (Week 1-2) : To determine needs and comprehend the project's scope, hold discussions with stakeholders, including customers, developers, and business owners.  
  Establish technical requirements and collect the required information (such as inventory API details and client interaction data).  
  Deliverables: Project plan and requirements paper.
* System Design (Week 3–4): Construct use case diagrams, design the database schema, and develop the system architecture. Describe system integration points and APIs.  
  Deliverables include use case diagrams, architectural diagrams, and a system design paper.
* Progress (Weeks 5-8)   
  Utilizing Natural Language Processing (NLP) models, create the chatbot and incorporate it with third-party systems (payment gateway, CRM, inventories).  
  - Create a front-end user interface so that users may communicate with the chatbot.  
  Deliverables: API integration and a working chatbot.
* Weeks 9–10: Testing and Validation   
  Conduct both functional and non-functional tests, such as usability, load, and stress tests.  
  Verify the chatbot's precision and effectiveness in answering user questions.  
  Deliverables include performance data, user reviews, and test results.
* Week 11: Deployment: Make sure the chatbot is fully integrated with the live database and external APIs before deploying it to the company's live environment.  
  - Make last-minute adjustments and launch.  
  Deliverables: Final report and deployed system.
* Support Following Deployment (Week 12)   
  Keep an eye on the chatbot's functionality, address any problems or bugs that crop up, and offer continuing assistance.  
  Deliverables: Constant upkeep and assistance.
  + 1. **Recommendations**

The researcher recommends the following about the system:

* + - The researcher recommends that users be trained how to interact with Chatbots so as to enable optimal performance of the system during user interaction
    - More research on this system is required to fully identify and eliminate some of the weaknesses and errors made during text processing and diagnosing diseases
    - There is need for the system upgrade as user’s requirements change. User requirements differ with time, therefore, it is of great help for the system to be flexible enough.
    - Other researchers can use this project report as a basis during future study of intelligent virtual agents in the medical sector.

# APPENDICES

## Appendix I: TIME SCHEDULE

With all factors kept constant, the following activities shall be completed done as scheduled

Tab 1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MONTH(s)** | **Jan 2025** | **Feb** | **2025** |  | **Marc**  **h, 2025** | **April**  **,** | **2025** |  | **May, 2025** |
| **WEEK(s)**  **TASK(s)** | 4 | **2** | **3** | **1** | **3** | **1** | **2** | **1** | **4** |
| Proposal research, writing  and presentation |  |  |  |  |  |  |  |  |  |
| System Requirements  gathering |  |  |  |  |  |  |  |  |  |
| System analysis and Design |  |  |  |  |  |  |  |  |  |
| System Development |  |  |  |  |  |  |  |  |  |
| System Testing and  Validation |  |  |  |  |  |  |  |  |  |
| Documentation writing and  Presentation |  |  |  |  |  |  |  |  |  |

## Appendix II: BUDGET

Tab 2

|  |  |  |  |
| --- | --- | --- | --- |
| **ITEM** | **QTY** | **COST PER QTY(ksh.)** | **TOTAL COST (ksh.)** |
| Laptop | 1 | 42,000 | 42,000 |
| Printing and binding | 1 | 300 | 300 |
| Internet Access | 10 GB | 2700 | 2700 |

|  |  |  |  |
| --- | --- | --- | --- |
| **TOTAL** |  |  | 45000 |

# References

Bannister, K. (2015). Understanding Sentiment Analysis: What It Is & Why It’s Used. *Brandwatch*. Retrieved from https://[www.brandwatch.com/blog/understanding-sentiment-analysis/](http://www.brandwatch.com/blog/understanding-sentiment-analysis/)

*.*

Darrington, J. (2015). *Importance of data flow diagrams.*

Frier, S. (2015). WhatsApp Hits 1 Billion Users, Fulfilling Zuckerberg’s Promise. *Bloomberg Technology*.

Retrieved from https://[www.bloomberg.com/news/articles/2016-02-01/whatsapp-hits-1-](http://www.bloomberg.com/news/articles/2016-02-01/whatsapp-hits-1-) billion-users-fulfilling-zuckerberg-s-promise

KADAM, S. (2016). DEPENDENCY PARSING IN NLP. *Shirish Kadam*. Retrieved from https://shirishkadam.com/2016/12/23/dependency-parsing-in-nlp/

Kiser, M. (2017). Introduction to Natural Language Processing (NLP). *Algorithmia*. Retrieved from https://blog.algorithmia.com/introduction-natural-language-processing-nlp/

Rouse, M. (2017). What is Tokenization. *Search Security Tech Target*. Retrieved from <http://searchsecurity.techtarget.com/definition/tokenization>

Schlicht, M. (2016). *https://chatbotsmagazine.com/the-complete-beginner-s-guide-to-chatbots- 8280b7b906ca.*

Yuan, M. (2016). Chatbots: Applications in customer service. Chatbot Development Journal.

Statsoft. (2018). Naive Bayes Classifier. Retrieved from <http://www.statsoft.com/textbook/naive-bayes-> classifier

Agile Alliance. (2017). Agile methodology for software development. Retrieved from https://www.agilealliance.org/agile101/

*.*

Techlabs M. (2017) (n.d.). HOW DO CHATBOTS WORK? A GUIDE TO THE CHATBOT ARCHITECTURE. *Maruti*

*Techlabs*.

Techopedia. (2018). Artificial Intelligence (AI). *Techopedia*.

Varone, M. (2016). Natural language processing applications. *Expert System*. Retrieved from <http://www.expertsystem.com/natural-language-processing-applications/>

Fischer, R. (2015). Machine Learning and AI in business automation. AI in Business Journal, 8(2), 45-60.

Wenzel, K. (2016). Database Normalization Exaplained in Simple English. *Essential SQL*. Retrieved from https://[www.essentialsql.com/get-ready-to-learn-sql-database-normalization-explained-in-](http://www.essentialsql.com/get-ready-to-learn-sql-database-normalization-explained-in-) simple-english