A WEB-BASED CUSTOMER SERVICE SOFTWARE INTEGRATED WITH A LARGE LANGUAGE MODE

CASE STUDY: CENTRE FOR TECHNOLOGY DISPUTES RESOLUTION – UGANDA

BY

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**DECLARATION**

I, **LUIGI MOREL**, declare that the work presented in this research project/ report is my original work and has not been submitted to any University or Institution of Higher Learning for any academic award. All work from other authors has been fully and properly acknowledged and cited.

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

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(Researcher)

**LIST OF ACRONYMS**

LLMLarge Language Model

GPT Generative Pre-training Transformer

BERT Bidirectional Encoder Representations from Transformers)

CTDRU Centre for Technology Disputes Resolution, Uganda

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**ABSTRACT**

This research studied the problem of customer service, responding and rectifying customer concerns in corporate organizations using Centre for Technology Disputes Resolution, Uganda as a case study.

Chief among the challenges that organizations face while handling customer responses is the lack of personnel to act as an interface between the organization and the customers. Furthermore, the amount of time spent responding to customer queries from potential consumers that do not convert into paying customers is a lot.

The main intent of this study was to develop a web based customer service software capable of using custom knowledge from an organization that serves customers.

A systems engineering methodology using the System development life-cycle approach was used to analyze, design and implement the developed web based system.

One of the major findings of this study was that the developed customer service system system can effectively respond to customers. This not only saves time, but also saves money in terms of hiring personnel to manually respond to customers each time they have queries.

The study recommends that pharmacies should use customer service software that is incorporated with transformed LLM data as a cost saving mechanism.

Incorporating technology into customer service has been shown to improve customer care service efficiency and responses in consumer facing organizations. This paper delves into the efficiency of incorporating large language model software into the daily operations of customer service teams in organizations.

# CHAPTER ONE

## Introduction

The quality of an organization's customer support services can be key to maintaining and extending its customer base and to its future survival. As such, accuracy and timeliness of information delivery to customers need to be considered if the organization cares about customer retention.

The most important benefits of customer service can be summed up in the following points:

* Customer service helps to retain customers.
* Customer service helps to encourage customer loyalty.
* Customer service helps to build a strong culture and reputation.
* Customer service helps to remain competitive in the marketplace.
* Customer service also helps improve employee satisfaction and retention.

However, to properly improve in information accuracy and timeliness needs a level of commitment from the organization’s management, in terms of:

1. Time to gather information about the common queries they receive from the customers and also to fine-tune the models so that they can accurately give correct information in response to customer queries.
2. The financial muscle to pay for the servers and other software services needed to effectively incorporate LLMs in their daily work
3. Investment in the personnel in terms of training so as to understand the processes involved in serving customers through web based software that has LLMs embedded into it.

## Background of the study

In today's digital age, customers expect rapid, personalized, and round-the-clock support from businesses across various channels, including websites, mobile apps, social media platforms, and messaging services. This poses a challenge to organizations to keep up with the demands of the modern day customer.

Centre for Technology Disputes Resolution, Uganda (CTDRU) is emerged as a public policy think tank providing cutting-edge insight and perspective into legal and regulatory solutions of the next generation technologies and their impact on the developing world. They help resolve Mobile Network Operators (MNOs) and subscribers with mobile money payment issues with third parties such as utility companies, for example, UMEME and other payment processors.

Traditional customer service approaches, relying on human agents or rule-based systems, CTDRU struggled to scale effectively while maintaining quality and consistency. Against this backdrop, the emergence of (LLMs) represents a paradigm shift in how CTDRU can address their customer service challenges.

LLMs, such as OpenAI's GPT (Generative Pre-trained Transformer) series and Google's, are pre-trained deep learning models capable of understanding and generating human-like text across a wide range of tasks. These models leverage vast amounts of text data to learn intricate patterns of language, enabling them to comprehend context, infer meaning, and generate coherent responses.

The integration of LLMs in customer service holds immense promise for revolutionizing the way businesses engage with their customers. By deploying LLM-powered chatbots, virtual assistants, and automated response systems, companies can streamline support processes, reduce response times, and deliver personalized interactions at scale.

Furthermore, LLMs have the potential to enhance self-service experiences by providing accurate and contextually relevant information to users, thereby reducing the burden on human agents and empowering customers to resolve issues independently.

## Problem statement

The rapid evolution of customer service expectations in today's digital era presents a significant challenge for businesses across industries. Customers increasingly demand timely, personalized, and efficient support experiences across a multitude of channels, including online platforms, mobile applications, and social media.

Traditional customer service approaches, reliant on human agents or rule-based systems, often struggle to meet these evolving demands while maintaining consistency and scalability. Moreover, the complexity and diversity of customer inquiries continue to grow, further exacerbating the strain on existing support infrastructure. Businesses face mounting pressure to provide round-the-clock assistance, handle a wide array of queries, and deliver responses that are not only accurate but also tailored to individual preferences and contexts. In response to these challenges, there has been a growing interest in leveraging artificial intelligence (AI) technologies, particularly large language models (LLMs), to augment and automate customer service operations. LLMs, such as OpenAI's GPT (Generative Pre-trained Transformer) series and Google's BERT (Bidirectional Encoder Representations from Transformers), have demonstrated remarkable capabilities in understanding and generating natural language text across diverse tasks. However, despite their potential benefits, the integration of LLMs into customer service workflows poses several significant challenges. Fine-tuning LLMs for specific industries or domains requires substantial computational resources, labeled data, and expertise in natural language processing (NLP). Moreover, concerns regarding model bias, ethical implications, and data privacy must be carefully addressed to ensure responsible and equitable deployment of LLM-based solutions. Furthermore, the dynamic nature of customer interactions necessitates continuous monitoring and adaptation of LLM-powered systems to maintain relevance and effectiveness. Without proper management and oversight, there is a risk of performance degradation, user dissatisfaction, and potential negative impacts on brand reputation. In light of these challenges, there is a pressing need for research and development efforts aimed at addressing the complexities of integrating LLMs into customer service operations. By exploring innovative strategies, best practices, and practical solutions, businesses can harness the transformative potential of LLMs to enhance customer experiences, streamline support processes, and drive competitive advantage in today's digital marketplace.

## General objectives

The main objective of this research was to design a web based customer service software for the customer response department at Centre for Technology Disputes Resolution, Uganda .

Below are the specific objectives:

1. To study and analyze the strengths and weaknesses of the current customer service processes.
2. To determine the specify the requirements of the new customer service software.
3. To design a new customer service software for Centre for Technology Disputes Resolution, Uganda.
4. To design, implement and test the new system.

## General research question

How can a web based customer service software integrated with a large language model for the customer service department at Centre for Technology Disputes Resolution, Uganda be designed?

## Significance

This study seeks to be a stepping stone for future academics and technical people in regard to the applicability of artificial intelligence in the day to day running of organizations while automating repetitive processes.

## Scope

This study only looked at the design of a web based customer service software for a technology disputes resolution organization. The design was done using dataflow diagrams (DFDs) and it was implemented on a Linux platform using tools such Hypertext Markup Language (HTML), Javascript, Python and CSS.

# CHAPTER TW0:**LITERATURE REVIEW**

## Introduction

Financial literacy is a crucial skill for individuals navigating the complex landscape of personal finance, particularly for university students who are often managing finances independently for the first time.

This chapter discusses literature that gives this study a theoretical basis. It specifically looks at the identification, location and analysis of documents, books, journals and reports containing information related to web/mobile application system brought by different authors.

Customer service is defined as an organization’s ability to meet the needs and desires of its customers. Excellent customer service is a vital part of solving technology related disputes, the kind of work handled by at CTDRU.

Technically, language modeling (LM) is one of the major approaches to advancing language intelligence of machines. In general, LM aims to model the generative likelihood of word sequences, so as to predict the probabilities of future (missing words).

Language models can be divided into four major development stages:

* *Statistical language models (SLM)*. SLMs are developed based on statistical learning methods that rose in the 1990s. The basic idea is to build the word prediction model based on the Markov assumption, for example, predicting the next word based on the most recent context.
* *Neural language models (NLM)*. NLMs characterize the probability of word sequences by neural networks, for example, multi-layer perceptron (MLP) and recurrent neural networks (RNNs).
* *Neural language models (NLM)*. NLMs characterize the probability of word sequences by neural networks, for example, multi-layer perceptron (MLP) and recurrent neural networks (RNNs).
* *Large language models (LLM).* LLMs is a type of artificial intelligence (AI) algorithm that uses deep learning techniques and massively large data sets to understand, summarize, generate, and predict new content. Examples of large language models include GPT (Radford et al., 2018), T5 (Raffel et al., 2020), and the most widely used GPT-3 (Floridi & Chiriatti, 2020; Scao et al., 2022), to mention a few.

## 2.1 Background for LLMs

Large language models refer to Transformer language models that contain hundreds of billions (or more) of parameters , which are trained on massive text data such as GPT-3, PaLM, Galactica, and LLaMA. LLMs exhibit strong capacities to understand natural language and solve complex tasks through text generation.

## **Key Aspects of an LLM**

To quantify an LLM in terms of its size, model complexity and training resource intensity, it is important to understand two concepts; parameters and tokens. They are the two important metrics used to measure the size and complexity of an LLM.

|  |  |  |
| --- | --- | --- |
| Metric | Description | Equivalence |
| Parameters | Numbebr of variables in the LLM’s neural network | More parameters = more complex LLM |
| Token | Fundamental units of text that the LLM uses to process and generate language | More tokens = more expressiveness of the LLM |

Table 1: A table explaining the concepts of tokens and parameters in LLMs.

## Use cases of large language models

* *Coding:* LLMs are employed in coding tasks, where they assist developers by generating code snippets or providing explanations for programming concepts. For instance, an LLM might generate Python code for a specific task based on a natural language description provided by a developer.
* *Content generation:* They excel in creative writing and automated content creation. LLMs can produce human-like text for various purposes, from generating news articles to crafting marketing copy. For instance, a content generation tool might use an LLM to create engaging blog posts or product descriptions. Another capability of LLMs is content rewriting. They can rephrase or reword text while preserving the original meaning.
* *Sentiment analysis:* Businesses harness LLMs to gauge public sentiment on social media and in customer reviews. This facilitates market research and brand management by providing insights into customer opinions. For example, an LLM can analyze social media posts to determine whether they express positive or negative sentiments toward a product or service.
* *Information retrieval:* LLMs can swiftly sift through extensive text corpora to retrieve relevant information, making them vital for search engines and recommendation systems. For instance, a search engine employs LLMs to understand user queries and retrieve the most relevant web pages from its index.

## Limits of LLMs

* *Bias amplification:* LLMs can perpetuate biases present in the training data, leading to biased or discriminatory outputs.
* *Ethical concerns and hallucinations:* They can generate harmful, misleading, or inappropriate content, raising ethical and content moderation concerns.
* *Interpretable outputs:* Understanding why an LLM generates specific text can be challenging, making it difficult to ensure transparency and accountability.
* *Data privacy:* Handling sensitive data with LLMs necessitates robust privacy measures to protect user information and maintain confidentiality.

# CHAPTER THREE: **RESEARCH METHODOLOGY**

## 3.0 Introduction

This chapter discusses the methods that will be used in data collection and data analysis. It also discusses methods that will be used in system analysis, design and implementation.

## 3.1 Research Design

This study will use both exploratory, descriptive, quantitative and qualitative research designs.

Exploratory research design is where the researcher will conduct research to investigate a problem which is not clearly defined. It will help the researcher to have a better understanding of the existing problem.

Descriptive research design will help the researcher to describe characteristics of a population being studied. Quantitative research design will help the researcher to discover how many people think, act or feel in a specific way.

It is defined as a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical or computational techniques. Qualitative research will help the researcher to obtain data through open-ended conversational communication.

This study will also be designed using the system development life cycle (SDLC). This is a conceptual model which includes policies and procedures for developing or altering systems throughout their life cycle. These stages are Project Planning, Gathering Requirements and Analysis, Design, Coding or Implementation, Testing, deployment, and Maintenance.

## 3.2 Requirements (Data) Collection Methods

This section discusses some of the data collection methods that will be used by the researcher to gather information in regard to this study.

### 3.2.1 Interview Method

An Interview method is a method where the researcher interfaces with the respondent with the goal of obtaining response from him/her.

In this study, the researcher will use this method to ask certain questions to the employees at CTDRU. With this method, there is accurate screening since there is face-to-face conversation and helps to trace out areas of misunderstandings, unrealistic expectations and future problems of the proposed system.

### 3.2.2 Questionnaire Method

A Questionnaire is a list of questions or items used to gather data from respondents about their attitudes, experiences or opinions. Questionnaire can be thought of as a kind of written interview.

The researcher will formulate a list of questions to form the questionnaire that will be given to the staff at CTDRU to get response or answers for the questions that will help the researcher more in solving the problem in this study.

The method will provide a relatively cheap, quick and efficient way of obtaining large amounts of information from the respondents. The researcher will not need to be present when the questionnaire is being attempted or completed.

### 3.2.3 Literature review

This will be used by the researcher to read the nature of questions that aggrieved parties pose to the staff at CTDRU. It assumes that the staff keep a list of questions with responses that they reference when they need to give a response to a party that’s seeking tech related disputes resolution. The researcher will use the obtained data to make informed decisions about the design of the applied LLM, web based user interface, functionality, navigation flow, and overall user experience.

**3.3** **System Development methods**

This is the framework that will be used to structure, plan, and control the process of developing the web based chat bot with an integrated large language model.

To accommodate the needs of CTDRU, we shall utilize the Agile Development methodology throughout the course of this research.

### 3.3.1 System Design

System design is the process of defining the architecture, product design, modules, interfaces and data for a system to satisfy specified requirements. This system will be designed using Data Flow Diagrams (DFD) as a tool.

### 3.1.2 Using Data Flow Diagram (DFD)

A Data Flow Diagram (DFD) is a graphical representation of the flow of data through an information system. DFDs can also be used for the visualization of data processing (structured design) and show what kind of information will be input to and output from the system, where the data will come from and go to, and where the data will be stored (Scheel, 2015)

**5.2.1 Reasons for using Agile Development Methodology**

Agile development has become popular and it’s usage continues to increase (VersionOne, 2014). Below are the reasons the researcher opted to use agile development methodology:

* Flexibility during the development process
* Improved quality due to frequent iterations
* Predictability of the processes in regards to the outputs

### 3.3.4 Graphical User Interface

The Graphical User Interface (GUI) will be designed based on the DFDs, providing a user-friendly interface for staff at CTDRU to interact with the customer support system. The GUI will include a

text input to allow users (customers with queries) to input text and get responses without human intervention.

The GUI will be designed using HTML, CSS, bootstrap and JavaScript as it acts as the interface between the system and the user.

The backend for the system will be developed using the Python programming language.

# 3.4 System Implementation

During this phase, the actual system coding is started, coding as per the design specifications, incorporating features such as expense tracking, budget setting, debt management, and financial reporting. The app's user interface, functionality, and database structure will be designed and implemented according to best practices and user feedback. The output of this step will be one or more product components built according to a pre-defined coding standard and debugged, tested and integrated to satisfy the system architecture requirement. A number of programming languages will be used and these include HTML, JavaScript, and MySQL.

### 3.4.1 System testing Methods

The goal of system testing is to detect for bugs as well as inefficiencies that may cause the system not to satisfy all its requirements before it is delivered or installed for the users to start using.

These will include functional testing to ensure app features like expense tracking and budget management work correctly, usability testing to assess user interface intuitiveness, compatibility testing across devices, performance testing for speed and stability, security testing to safeguard user data, and user acceptance testing with real users to gather feedback and ensure the app meets user expectations. These testing methods collectively aim to validate the app's functionality, usability, performance, security, and user satisfaction, ensuring it effectively supports student financial literacy and management needs.

### 3.4.2 System Validation Methods

System Validation refers to confirmation by examination and provision of objective evidence that software specifications conform to user needs and intended uses, and that the particular requirements implemented through software can be consistently fulfilled. (Rodrigo, 2018)

These validation methods collectively aim to ensure that the web based customer service chat bot effectively meets the customer support requirements of staff at CTDRU.

User testing, including usability testing and user acceptance testing (UAT), to validate the chatbot’s functionality and user satisfaction.

## 3.5 Chapter Summary

This chapter presents the research methodology for studying the Personal Finance Management System (PFMS) mobile app at Kyambogo University. It employs exploratory, descriptive, quantitative, and qualitative research designs to gather comprehensive insights. Data collection methods include interviews, questionnaires, and observations to understand

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