AI voice assistant for smartphones with NLP techniques

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***Abstract*— Accidents happen mostly as a result of using mobile applications while driving. The AI voice assistant mobile application was developed to aid drivers in operating their mobile phones while driving without touching their phones. The application is also a huge benefit to the visually impaired and any smartphone user. The literature review examines multiple innovative artificial technologies involved in applications with voice assistants in natural language processing (NLP) techniques. The methodology used involved a qualitative approach, and the design science paradigm was used for the development of the voice assistant for smartphones with NLP techniques. NLP techniques that were applied in the development of the AI voice assistant are smart synthesis, data flow sequence, core and interface accessing, part of speech tagging, named entity recognition, conference resolution, and porter stemming. Some of the operations that are achieved by the application include arithmetic calculations based on voice commands and returning the computer result via voice, searching the internet based on user voice input, and providing a response via voice assistance.**

Keywords: Algorithms, Android, AI voice assistant, iOS, Natural language processing, Machine learning

I. INTRODUCTION

A voice assistant is a system that listens to voice commands and responds with pertinent information, as well as carrying out tasks as asked by the user. The main goal of the AI voice assistant for smartphones is to lessen the number of accidents that are due to physical interaction with smartphones while driving. Driver distraction is increasingly recognized as a significant source of injuries and fatalities on the roads (1). Distraction can arise from visual or manual interference, for example, when a driver takes his or her eyes off the road to interact with a smartphone (1). Concern over inattentive driving due to the use of smartphones is growing as more and more smartphones are being used while driving. According to a report by the National Safety Council of the United Kingdom in 2019, mobile phone usage while driving caused 1.6 million car accidents worldwide (7). More than 390,000 people in the United Kingdom received injuries in accidents caused by the use of smartphones while driving (9). It is against the law to use a smartphone or any other type of phone while operating a motor vehicle, not only in Zimbabwe but also in other countries as well. It is illegal to use a phone while operating a vehicle under Section 116 of the Zimbabwe Statutory Instrument 199 of 2000. People who are able to use their voice to input a command are able to use the voice assistant application. In today's

society, there are an increasing number of activities that may be carried out online, including texting, buying food, and purchasing train tickets. Nearly all of these internet services require user input, and this can be achieved through the use of smartphones. The application of natural language processing (NLP) techniques can be found in many fields, including healthcare and finance, among others. NLP techniques are used to develop intelligent virtual assistants, chatbots, and search engines that can comprehend the real world. They also have applications in many state-of-the-art technologies like sentiment analysis, fraud detection, and language translation.

II. BACKGROUND

Natural Language Processing (NLP) has existed since the beginning of the 1950s and 1960s. The creation of the first translator was the opening of this amazing technology (5). The development involved the translation of Russian to English and vice versa. Parsing algorithms followed right after the first translator; the technology focused on grammatical errors, semantics, and the definition of words and phrases. Statistical methods came into the picture around the 1990s, which led to the training of models for big data. Techniques such as part-of-speech tagging, entity recognition, and sentiment analysis came into play right after the introduction of statistical data. Deep learning techniques came into play, introducing revolutionized NLP with neural networks such as the K-Nearest Neighbors Algorithm (KNN), Convolutional Neural Network (CNN), recurrent neural networks (RNNs), and transformers. These models have achieved state-of-the-art results on a wide range of NLP tasks, including language translation, language modeling, and text classification. These models can be applied to different applications to solve different community problems. The applications can be accessed through the use of hand-held smart gadgets, laptops, desktops, and any other digital devices. Smartphones give access to a wider audience, as most people in Zimbabwe now own a smartphone (2).

Since the onset of smartphones, there have been noticeable setbacks associated with the use of smartphones while operating mobile devices. The use of smartphones for activities such as making calls, texting, playing music, and map and location navigation is cited as having contributed to road carnage by a larger margin. According to the Zimbabwe Republic Police (3) biannual report, an average of 57 road traffic accidents in Chinhoyi are attributed to the operation of smartphones while driving. The ZRP and Traffic Safety Council of Zimbabwe (TSCZ) used to carry out awareness campaigns to try and mitigate the disheartening figures of smartphone-attributed accidents. On another note, continuous use of smartphones results in numerous eye problems (3). With the advancement in mobile chat technology, users are lured to spend most of their time glued to social media interactions such as Facebook, WhatsApp, SMS, and many more. There is a need to formulate innovative techniques that facilitate interaction with smartphones so that the need to constantly glance at the screen is reduced (4). The use of smartphones through voice commands will limit continuous staring on the LCD, thereby curbing eye problems.

The development of the AI Voice Assistant Application, which is capable of converting speech to text and text to speech, will enable users to navigate their mobile applications by simply using their voice. The application allows drivers to make calls, text, and play music without physically handling the smartphone. With the rise of technology, the use of smartphones has become the order of the day. The user of the application uses voice commands to operate the smartphone, from reading messages to calling. The application converses in the same way some individuals converse with any other person. The AI Voice Assistant application has a trained dataset in the English language and also in the Shona native language. With NLP techniques, any command from those two (2) languages, a smartphone can be operated. NLP techniques that were applied in the development of the AI voice assistant are smart synthesis, data flow sequence, core and interface accessing, and porter stemming size. If you are using US letter-sized paper, please close this file and download the Microsoft Word, Letter file.

III. LITERATURE RIEVIEW

The literature examining various voice assistant systems with NLP techniques is thoroughly analyzed in this section. The general public is becoming more and more accustomed to using voice assistants like Siri, Alexa, Google Assistant, Cortana, and Bixby on their smartphones. Voice assistants (VA) have a significant impact on how people use their smartphones and aid in societal advancement. Innovations inartificial intelligence (AI) and specialized systems have givenrise to the voice assistant application as a new method of interaction. The literature review describes the key ideas in pertinent publications, identifies research gaps, and assesses each publication's contributions to the issue (5).

A. Voice Assistant Application for Avoiding Sedentarism in Elderly People Based on IoT Technologies

The voice assistant application is an Internet of Things (IoT) system that uses virtual voice assistants, which includeIoT gadgets and activity-tracking smart bracelets, to prevent elderly people from becoming sedentary (12). Sedentarism isthe term used to describe a wide range of "activities" that require low energy consumption, which includes sitting, lying down, sleeping, reading, and other similar activities (12). Predominantly among the elderly, sedentarism can raisethe prevalence of diabetes, obesity, cardiovascular disease, and many others. Therefore, this voice assistant system provides solutions that allow the elderly to monitor their dailyphysical activity simply by using their voice and consequently prevent them from adopting sedentary patterns(15). According to (1) the voice assistant application allows the elderly to create sporting challenges to be achieved throughout the day using VA, which involves finishing a specific number of steps to keep them moving throughout the day. The natural language techniques (NLP) that were used in the development of this voice assistant include natural language understanding (NLU) and named entity recognition(NER). In addition, as the day goes by, the system provides feedback through voice messages, following basic gamification guidelines, until the set goal is achieved, at which time the user will be congratulated for the achievement(2). The smart bracelet records daily activity and keeps trackof the user's progress. An edge computing device (ECD) collects data from the smart bracelet.

B. Android-based voice assistant for blind people

This voice assistant application was developed in 2018 andperforms tasks given by the user via voice commands. The software uses AI and machine learning to recognize the user'svoice (14). The software's intention came from the idea of a virtual personal assistant and a cognitive assistant that can learn and organize. Intelligent software assistants combine traditional artificial intelligence approaches to try to create apersonal assistant program that can evolve through its interaction with the user (2). Basically, this system was developed with the intention of providing users with a terrificexperience that would improve their everyday productivity. The application was primarily created for those with vision impairments. To open the application, the user must shake thedevice, and if the device detects a shake, then the system says,"Please enter the command after the following note" (3). Thenatural language techniques (NLP) that were used in the development of this voice assistant include named entity recognition (NER), a talkback screen reader for Android devices, speech synthesis to read out speech on the screen, and text-to-speech conversations to allow users to speak to their own commands on the devices. The user may then beginusing the app with voice commands, and to launch programs,they only need to speak the phrase "open" followed by the name of the application, for example, "Open Facebook". Thesystem will try to confirm with the user by asking this question, "Are you sure you want to open?" If the user says "yes,", then the system will immediately open the application; otherwise, the system will cancel the given command (11).

C. Abena AI Voice Assistant

Recently, all walks of life have preferred voice assistants as the most effective way of interacting

with their devices. They use voice commands to perform activities on their devices while their hands are free from holding the device. As far as developers develop AI voice assistant applications, (6) developed the first voice assistant fluent in Twi (also called Akan Twi), the most widely spoken language in Ghana. This application was meant for Ghanaian natives as it was developed in the Twi language and designed for old people. Abena can monitor trending news on Twitter, follow weather reports, check, transfer, recharge, and transfer money with their preferred mobile payment app (7). In addition to text messages, photographs, and videos, the offline mode offers an in-app community feature that allows users to communicate with one another via text messages, images, and videos (8). Abena Voice Assistant was launched in April 2022 and was updated on October 20, 2022. The natural language techniques (NLP) that were used in the development of this voice assistant include natural language understanding (NLU), data flow sequence, porter stemming, and named entity recognition. These techniques allow the user to ask questions like what the weather is like or the position of a specific geographical area. With the above capability, Abena is on the trend in Africa by being able to understand the Twi language, thereby being widely accepted in the locality of Ghana. This system goes a long way in enhancing the use of mobile gadgets by the elderly through voice commands in the nation of Ghana.

D. Alexa, Siri, Cortana, and Google Voice Assistants

Voice assistants understand spoken language and respond with artificial voices. The most widely used voice assistants are Google's Assistant, Apple's Siri, Amazon's Alexa, and Microsoft's Cortana, and they are all built into smartphones or specific home speakers (9). Apple's Siri assistant was released in 2010 and was integrated into iOS in 2011. Siri Assistant is only compatible with Apple devices, which include iPhones, Macbooks, iPads, and Apple Watches. Microsoft released Cortana in 2013, and it is embedded in PCs with the Windows OS. Amazon launched Alexa with its Echo-connected home speaker in 2014 and can also be used on Android smartphones (10). Google Assistant was introduced in 2016 and comes embedded in Android phones. These voice assistants are able to perform basic tasks such as sending and reading text messages, making phone calls, sending and reading email messages, and setting timers, alarms, and calendar entries (2). They have control over IoT-enabled items like locks, lights, thermostats, alarms, and electrical appliances. These voice assistants act as a conduit, allowing users to utilize voice commands rather than manual controls to operate their smartphones. Although voice assistants perform important functions, they are coupled with security and privacy issues. Security is compromised when anyone with access to a voice-activated device can ask it questions, gather information about the accounts and services associated with the device, and ask it to perform tasks (5). Due to the device's ability to read aloud emails, calendar entries, and other sensitive personal data, this poses a serious security issue. Google has recently upgraded its Assistant software to include voice printing, which uniquely identifies each user by voice and prevents the device from reading out personal information (13). In addition, privacy is another issue of concern for voice assistants. Voice assistant-enabled devices must always be listening so they can respond to voice commands given by the user. Amazon, Apple, Google, and Microsoft all insist that their devices are not recording unless users speak the command to wake the assistant, but there has been at least one case where a malfunctioning device was recording at all times and sending those recordings back to Google's servers (13). The most common NLP techniques used in these voice assistants are natural language understanding, intent recognition, context tracking, and part- of-speech tagging. Although the developers of these voice assistants may be cautious and trustworthy, there are possible threats of cyberattacks that may result in data breaches, leakage, or be used to incriminate users. For instance, a murder investigation in Arkansas led to the authorities issuing

E. Literature Summary

A voice assistant application for avoiding sedentarism in elderly people based on IoT

technologies was reviewed. Dueto its low computing capabilities, the ECD sends data to remote cloud services, where it is securely stored so that it may be accessed by other IoT devices. When there are no nearby remote cloud services, the functionality of the system falters, including the absence of the internet. An Android- based assistant for blind people requires a large dataset of voice commands and quick executions. If any commandoutside the ones in the dataset is given, the command operation falters. To make sure that the applications remain fully operational, the operator has to be trained on the voice commands, which are tailor-made for the application. AbenaAI Voice Assistant's scope was too limited, as it addressed the problems of the natives of Ghana. The use of localized language promotes the limitation of the universalism of the system. The application's communication language limits users who do not speak the Ghanaian language. This application was developed in a language not familiar to othersmartphone users and mobile applications, which limits Abena's interoperability with other mobile applications. Theproposed AI voice assistant application uses the Englishlanguage, which has a greater reach among people around theglobe. Siri only functions on iOS devices and is not compatible with other operating systems. Alexa Voice Assistant requires the user to create an Amazon account before using it, and Google Voice Assistant only operates if the smart gadget is connected to a Google account. Without the accounts, there is no access to these voice assistants. TheAI voice assistant application surpasses all these barriers by operating without an account and by using NLP techniques, which are mostly common in the reviewed projects. The AI voice assistant has the ability to set reminders by speech, read messages, make calls, and perform many other operations.

IV. METHODOLOGY

The purposeful sampling method was used to gather primary data. In order to have interview access to quite a number of felony drivers, researchers went to the ZRP Chinhoyi traffic station. This was done to have a specific sample of the drivers who used smartphones while driving. There were **89** drivers who were brought to the station, and nine of them were interviewed. Among the **89** drivers, nine **were** randomly selected to represent the actual sample to be used. The information derived from these interviews contributed to the development of the AI voice assistant for smartphones. Some of the questions asked in the interviews include:

1. Why did you choose to use your smartphone whileyou were driving?
2. Were you aware of the major dangers involved in theuse of smartphones whilst driving?
3. Would you be open to using an AI voice assistant that can assist you with your smartphone operationswhilst driving using voice commands?
4. How do you think an AI voice assistant can assist you in the operation of your smartphone when you are driving?
5. What major operations would you want the AI voiceassistant application to manage?

Drivers were observed at a road site (Hunyani Bridge alongHarare-Chirundu road) where traffic flows in and out of Chinhoyi town. The researchers decided to observe traffic during the rush hour between 1300 and 1400 hrs. 58 cars, 7 buses, and 23 trucks were observed to make a total of 88 traffic observed. This necessitated and justified the development of an AI Voice Assistant.

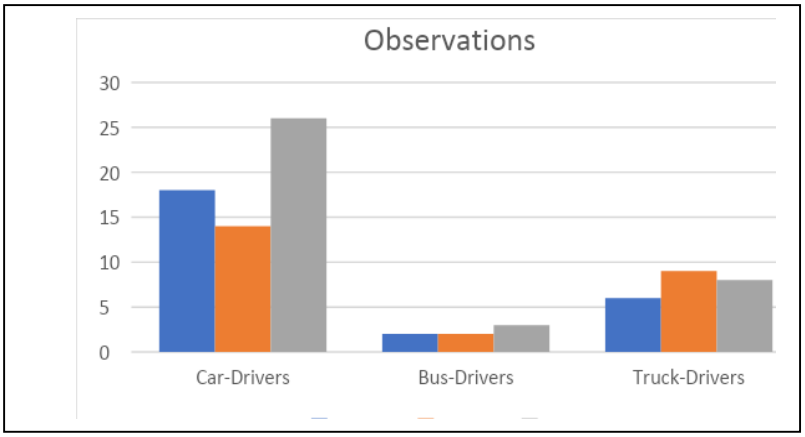

Fig. 1. Observed Traffic.

The design science approach was used as a problem- solving paradigm that enhanced human knowledge via the creation of innovative artifacts (12). The use of smartphonesby drivers to text and make calls while driving is increasing the number of road traffic accidents. This is frequently observed around holidays, when fatal road traffic accidents are recorded as a result of drivers physically operating their smartphones and communicating with their loved ones whiledriving. A lot of time is spent locating misplaced smartphones, especially in the darkness, and this has caused many delays in smartphone users' carrying out their routine activities. This step involved the development of an AI voiceassistant application that handles intents on a smartphone. This assists drivers, the visually impaired, and any other smartphone user to use voice commands to control their smartphones, thus enhancing two-way communication between the user and the smartphone. With the expected requirements well defined, researchers specifically identifiedthe software and hardware that were needed for the development of the AI voice assistant, and the system design was crafted. The Flutter framework and Dart programming language were utilized to develop the application. Machine learning algorithms were used to train NLP models on the preprocessed data. The models were trained to recognize andinterpret natural language commands and questions. Thesystem was broken down into small functions and tested for robustness as the system units to check if it was fulfilling user expectations. The tested units were merged to form the AI Voice Assistant application holistically. The system was tested to see if any debugging was necessary. However, it was ready for deployment. Both non-functional and functional user requirements were tested and completed.

V. MODELS USED IN THE AI VOICE ASSISTANT FOR SMARTPHONES WITH NLP TECHNIQUES

For the AI voice assistance application to work, it requiresmodels that undergo a small process. There is model selection, data preparation, training, evaluation, fine-tuning, deployment, and interactive tuning. The model that the studyselected for training is the OpenAI's GPT-3. Pre-training: A sizable corpus of text from the dataset that is accessible to thepublic is presented to GPT-3 during pre-training. With the context of the words that come before it, the model learns to predict the word that will come after it in a particular sentence. In doing so, GPT-3 is able to identify patterns, semantic connections, and linguistic structures seen in the training set. In order to accomplish this, GPT-3 uses a transformer architecture, a deep neural network model that effectively processes sequential data. Feed-forward and self-attentional neural networks are layered to generate the transformer. GPT-3 is fine-tuned for particular activities or domains following pre-training. A smaller dataset that is more pertinent to the intended application is

used to train the model during fine-tuning. Fine-tuning GPT-3 on a dataset including weather-related queries and responses, for instance, if you wanted to create a voice assistant for weather information. Using a smaller dataset unique to the job at hand, the model's parameters are changed during fine-tuning. The desired outputs and inputs are labeled in this dataset. Through the use of task-specific training data, GPT-3 adjusts its previously acquired knowledge to meet the demands of the voice assistant application. A speech recognition system that transcribes spoken words into written text is required in order to enable voice commands. The speech-to-text command is implemented into the model using Google Cloud Speech-to-Text services. After the spoken language has been translated into written form, there is utilization of natural language understanding (NLU) techniques to decipher the user's intent and collect pertinent data from the text. NLU encompasses tasks such as slot filling, intent classification, and entity recognition. This makes it possible for you to decipher voice commands and retrieve the parameters or instructions required for additional processing. Since GPT-3 is essentially a text-based model, it may be added to the voice assistant pipeline after the NLU and speech recognition phases. GPT-3 can be given the voice recognition system's transcribed text to better comprehend and produce relevant responses. Based on the provided context, GPT-3 can process the content and generate natural language responses. A text-to-speech system can be used to translate the text response that the GPT-3 generates back into spoken language. To turn the generated text into an audio response, TTS solutions such as Google Cloud Text-to-Speech can be utilized.

VI. RESULTS AND DISCUSSION

After the arrested drivers were interviewed by the researchers, they gave reasons why they were using their smartphones while driving. Some told the researchers that they were answering important calls from home, some were looking for directions, and some were just addicted to social media. In terms of being aware of the dangers of using smartphones while driving, most of the drivers were quite aware but decided to use the smartphones anyway. As most drivers proved to be very attached to their smartphones, they were very open to the fact of having an application that would allow them to operate their smartphones without breaking road rules or endangering passengers. They liked the idea of an AI voice assistant assisting them in answering calls without taking their eyes off the road.

The NLP techniques used needed to be tested, and the data in **Table 1** below shows the final outcome of the tests. Voice Assistant continues to learn the sequence of queries relevant to its context that it recalls for the future. Part-of-speech tagging is a technique used to identify parts of speech. Parts of speech include nouns, verbs, pronouns, adjectives, and many other forms. Named entity recognition is used to identify and classify specific entities. People, objects, organizations, and places come as examples of entities. Conference resolution is used to determine when two or more words refer to the same entity in text. A speech synthesizer comes into play as it converts written text into speech. Data flow sequence refers to how data is processed in machine learning. Core and interface assessment and porter stemming are all connected to text processing. All these techniques work together and are interlinked in the AI voice assistance application for smartphones. It does arithmetic calculations based on voice commands and returns the computer result via voice. Search the internet based on user voice input and provide a response via Voice Assistance. After analyzing the data, train the model with natural language processing techniques and calculate the accuracy for each model, as shown in the table below:

TABLE I. MODEL ACCURACY

S.No	Model	Accuracy %
1	Speech Synthesizer	96.3
2	Data flow sequence	94
3	Core and interface assessment	94.2
4	Porter Stemming	92.6
5	Part of speech tagging	95
6	Named entity regulation	93.6
7	Conference resolution	96.4

Various algorithms are utilized in this work based on the analysis. A comparative analysis was conducted among several technologies, such as speech synthesizers, data flow sequences, core and interface accessing, and porter stemming. All the results acquired had a percentage higher than 90 percent. The percentage shows the success rate of the in unison and produce accurate results which makes the application ideal for its purpose.

VII. CONCLUSION

AI voice assistants with NLP techniques play a big part in our daily lives since the application allows us to interface with our devices directly and allows users to voice command almost all of an application's functions. The application brings about convenience, efficiency, ease of use, and enjoyment among smartphone users (13). By automating routine chores and transferring them to a voice-activated personal assistant, the AI Voice Assistant Application assists the visually impaired and drivers. The application assists drivers with navigation to their destinations and any smartphone operation without physically touching the screen. The AI Voice Assistant Application enables users to navigate through smartphone applications using voice commands, making it possible for folks who have poor vision to use their smartphones. Additionally, the application can be used by anyone who owns a smart device using voice commands. It also assists those who have misplaced their smartphones by simply calling them when they are nearby since it will be able to recognize the owner's voice (by using voice recognition). Furthermore, this application can efficiently complete these menial tasks without making mistakes, which frequently results in an increase in customer satisfaction. Unlike other systems, like Siri, which only function on iOS devices, the AI voice assistant application is compatible with both iOS and Android. In addition, this will be free, and anyone may use it without having to first have an account. For instance, the Alexa voice assistant requires the user to create an Amazon account before using it. The AI voice assistant application that we intend to develop requires the user to enter a few voice validations before using it, and this is an aid to security on the smart gadget as it cannot be used by anyone's voice besides that of the owner. The AI Voice Assistant for Smartphones developed is important for every Zimbabwean with impaired vision, as it will improve services for their eyesight and protect drivers from accidents attributed to the use of smartphones while driving. It assists people who have misplaced their smartphones by simply calling the device, and it recognizes the owner's voice through the use of voice recognition.

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