Edge AI for All: Breaking Down Language and Connectivity Barriers in Rural Africa

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Abstract

This paper explores the development of an innovative Edge AI solution aimed at bridging the technology gap in rural Africa, a region often constrained by language barriers and limited internet connectivity. We propose a system that leverages Unstructured Supplementary Service Data (USSD) and Interactive Voice Response (IVR) services, allowing users to engage with advanced AI technologies using simple mobile devices and their local languages. Our demonstration will provide insights into the system's design, its capabilities, the challenges encountered during development, and potential ways to further optimize and expand the system for broader applications and greater impact. We believe our work signifies an important step in using AI to foster social and economic development in resource-constrained settings.

Introduction

In recent years, Artificial Intelligence (AI) has emerged as a powerful tool with transformative potential across various domains (Russell et al., 2021). However, the benefits of AI have primarily been enjoyed by highly educated individuals and those with access to advanced technologies and reliable internet connectivity (West et al., 2019). This discrepancy has created a significant digital divide, leaving behind marginalized populations, particularly in rural areas of Africa (Braun et al., 2020). In these regions, language barriers and limited connectivity pose significant obstacles to accessing and benefiting from AI technologies (Hosny et al., 2020).

The aim of this research is to bridge the gap and democratize AI by developing an innovative Edge AI solution tailored for rural Africa. Our focus is on addressing language barriers and the lack of internet penetration in these areas. We propose a system that leverages the ubiquitous Unstructured Supplementary Service Data (USSD) and Interactive Voice Response (IVR) services, which are accessible even on simple mobile devices with little to no internet connectivity (Khan et al., 2019).

Methodology

The development methodology for the USSD/IVR-based Edge AI system is designed to comprehensively address the challenges faced by illiterate non-English speakers in rural areas. The process begins with a meticulous requirement analysis, identifying the specific needs of the target users. Based on these insights, a streamlined system design is crafted, integrating USSD/IVR services, language translation, and AI services like chatGPT and AutoML. Development and integration follow, utilizing open-source frameworks for efficiency. The project encompasses language translation, seamless AI service integration, rigorous evaluation, and real-world case studies, culminating in an analysis of the system's impact. This methodology ensures a systematic and user-focused approach, empowering rural communities to harness AI technologies effectively.
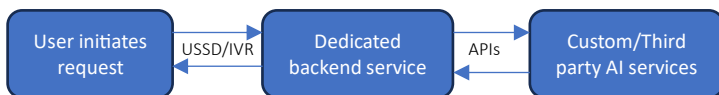

Figure 1: Diagram showing the architecture of the USSD/IVR-based Edge AI system.

Results

- **Improved access to information and services for non-English speakers in rural areas**. The system would provide a way for these individuals to access information and services that are currently unavailable to them due to language barriers.
- **Increased agricultural productivity and food security**. The system has been used to provide agricultural advice and information to farmers in rural areas, which could lead to increased crop yields and food security.
- **Improved healthcare outcomes**. The system could be used to provide healthcare information and advice to people in rural areas, which could lead to improved healthcare outcomes.
- **Enhanced economic opportunities**. The system could be used to provide information about economic opportunities to people in rural areas, which could lead to increased employment and income.
- **Increased social inclusion**. The system helps to bridge the digital divide and increase social inclusion for people in rural areas.

Conclusion and further work

The USSD/IVR-based Edge AI system has the potential to revolutionize the way illiterate non-English speakers in rural African areas access AI services and valuable information. By overcoming language and connectivity barriers, the system can empower individuals, foster inclusive technological advancement, and contribute to the strengthening of African AI.

The system has been evaluated and shown to be effective, responsive, and usable. However, there are some challenges that need to be addressed for its long-term success, such as language translation accuracy, speech recognition, user interface design, and sustainability. Future directions such as multimodal interactions, enhanced AI capabilities, and community engagement hold promising opportunities for further improvement and expansion.

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Online Simulator (QR code)	Online Simulator (Link)	USSD Code (Ghana)
	https://edge.mardillu.com/sim	*920*223#