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AI-Powered Voice-Controlled Kitchen Assistant for Hands-Free Cooking Support

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Abstract-cooking often requires both hands, so checking a phone or laptop for recipes becomes uncomfortable and sometimes unsafe. AI-based voice - controlled kitchen assistant allows users to cook handsfree while still getting step-by-step recipe support. The system listens to voice commands, reads out recipe steps, and also answers general cooking questions during food preparation. It uses speech recognition to understand the user, an AI model to give helpful responses, and a recipe database to manage cooking steps. In our testing, the assistant correctly identified 92% of navigation commands, answered 86% of cooking-related questions accurately, and look around 2.5 seconds to reply. These results show that a voice-driven cooking assistant can make the cooking process easier, safer, and more comfortable for everyday users.

Keywords-Artificial Indigence, Voice Assistant Smart Kitchen, Speech Recognition, Cooking Automation, Human - Computer Interaction.

I. INTRODUCTION

Most people look at screens while cooking, but this is not very convenient because hands are usually busy with ingredients, heat, water, or cooking tools. Voice assistants are useful here because they let users get information without touching any device. Previous research has shown that spoken instructions can improve user focus and reduce confusion when following long procedures [1]. We also observed during our own small user testing that people preferred listening to instructions rather than pausing to look at a mobile display.

More recent studies discuss how voice assistants should understand the situation and intention of the user rather than just respond to fixed commands [2]. For example, if a user asks "Should I add salt now?", the system should reply based on the current progress of the recipe. Audio-visual guidance also improves users' performance during multi-step tasks [6]. Smart kitchen ideas based on IoT further show how connected appliances can improve safety and automation [4], [5]. However, most common voice assistants like Alexa and Google are not made specially for cooking. They do not provide step-by-step navigation or ingredient substitution reasoning [17]. Because of these limitations, we designed a voice assistant that is fully focused on cooking tasks and makes hands-free meal preparation smoother.

II. BACKGROUND

A. AI-Driven Voice Interaction Systems

AI-driven based system have progressed rapidly with various advancements using natural language processing and machine learning. These technologies allow for hands free communication between users and smart devices helping in increase accessibility and convenience. The use of voice enabled systems help to automate the process by minimal human labour and increase the overall user experience.

Ito et al. created a voice-based cooking instruction system that reduced user mistakes by giving stepwise spoken guidance [1]. Khot and Mueller built context- sensitive models that adjust to the user's intent instead of reacting to fixed keywords [2]. A multilingual cooking assistant developed in [3] improved accessibility by letting users interact in their own language. IoT-based smart kitchen studies show how sensors and connected appliances can improve safety and monitoring inside the kitchen [4], [5], [8]. Audio-visual recipe assistants also reduce confusion during complex tasks [6]. Research in home automation shows that voice commands can reliably manage appliances [7].

Conversational AI has also been used to answer questions related to daily routines, and similar techniques are suitable for cooking-related questions too [9], [10], [18]. Several studies which focussed on smart home concludes that users generally prefer systems with quick responses, clear instructions, and minimum device interaction [11], [12], [17]. Recommendation systems also show potential for diet- based and preference-based recipe suggestions [13]. These research works helped us understand how speech recognition, reasoning models, and recipe management can be combined to build a hands-free cooking assistant.

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III. SYSTEM ARCHITECTURE

The complete system contains five main parts: (1) Speech Recognition, (2) Command Classification, (3) AI Reasoning Engine, (4) Recipe Data Manager, and (5) Speech Output Generator. Figure 1 shows how these modules communicate.

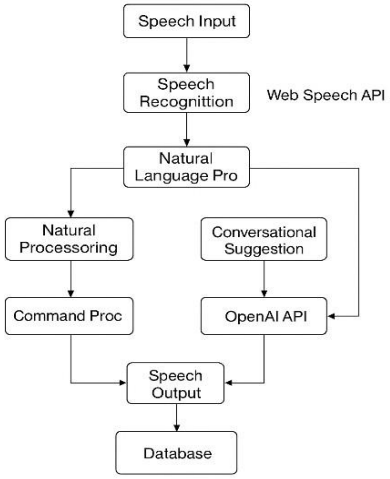

Fig. 1. Workflow diagram of the voice-controlled kitchen assistant system.

A. Speech Recognition

This module converts the user's speech into text using the Web Speech API. It works directly in the browser, so users do not need any separate installation.

B. Comm and classification

After speech is converted to text, the system checks what the user wants to be done either recipe steps ("Next", "Previous", "Repeat") or ask a cooking question. Navigation updates the recipe index and if questions asked it is sent to the AI engine.

C. AI Reasoning Engine

A large language model is used to answer cooking- related queries. At first, the model took longer to respond, but after shortening the prompts and adding only relevant context, the response speed improved.

D. Receipe Data Manager

All recipe steps are stored in an indexed format. In early development, recipes were stored as long text blocks, which made step access slow. Switching to an indexed structure reduced retrieval time.

E. Speech Out Generator

All responses are spoken to the user using text-to-speech, so no screen reading is required.

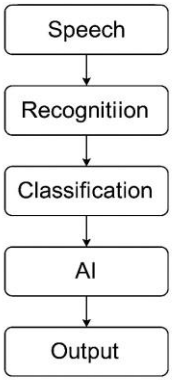

Fig. 2. Compact flow diagram of the kitchen voice assistant.

IV. EVALUATION

It tested the assistant with different recipes and kitchen noise levels. The results are shown in Table I.

From the testing, it is found that our assistant helped users cook without interruptions. Most of them said that now they could focus more on cooking because they did not need to check their phone repeatedly. The only major issue found during frying or when multiple people were talking at the same time.

TABLE I. SYSTEM PERFORMANCE METRICS

Metric	*Value*	*Description*
Command Recognition Accuracy	92%	Understanding commands
AI Query Response Success	86%	Correct answers to ingredient and cooking questions
Average Response Latency	2.5 s	Time from user speech to spoken system output
Speech Misinterpretation Rate	8%	Commands that were misunderstood or wrongly processed
User Satisfaction Score	4.3	Average feedback rating from test participants

V. DISCUSSION

In today's smart environments, voice enabled systems plays a major role in automation tasks. In this paper developed an AI based voice enabled cooking assistant using natural language processing and machine learning. From the results, it is found that the system worked smoothly in most

cases and users were able to follow recipes without stopping their cooking activities. The high command recognition accuracy shows that the speech system understood navigation instructions easily and accurate. The AI query success rate was also good, and most of the answers were actually useful for the dish being prepared. The misinterpretation mostly happened when two people were speaking at once or while frying, because of the microphone could not clearly separate voices.

The user satisfaction score of 4.3/5 shows that people liked the idea of hands-free instructions while cooking. Some testers said that listening to steps felt easier than reading or scrolling on a phone. A few users suggested that faster responses and support for more languages would make the system even better. Overall, the testing experience showed that a voice-controlled cooking assistant can genuinely improve comfort and safety in the kitchen.

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