

Sahi-Ration: An AI-Powered WhatsApp-Based Ration Card Verification System for Rural Beneficiaries in India's Public Distribution System

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Abstract—India's Public Distribution System (PDS) serves over 800 million beneficiaries by providing subsidized food grains through a network of Fair Price Shops (FPS). Despite its scale, rural beneficiaries often struggle to verify their ration card entitlements due to limited awareness about monthly allocations, digital illiteracy, and language barriers. This paper presents Sahi-Ration, a WhatsApp-based ration card verification system that uses artificial intelligence to address these challenges.

The system works by allowing beneficiaries to send a photograph of their ration card via WhatsApp. It uses EasyOCR to extract the Ration Card ID from the image, retrieves beneficiary details from a Google Sheets database, and uses LLaMA 3.3-70B via the Groq API to generate a personalized response in Hindi. The response is sent back as both a text message and an audio message using Google Text-to-Speech (gTTS), making it usable even for people with low literacy levels.

The backend is built with FastAPI, workflow automation is handled by n8n, WhatsApp messaging is done through Twilio, and ngrok is used for tunneling during development. Testing showed successful end-to-end verification with an average response time under 60 seconds. Sahi-Ration provides a practical, low-cost approach to improving transparency and accessibility in India's PDS.

Keywords—Public Distribution System, OCR, WhatsApp Bot, Hindi NLP, Text-to-Speech, LLaMA, FastAPI, n8n, Rural Technology, Artificial Intelligence

I. INTRODUCTION

India's Public Distribution System is one of the world's largest food security programs, covering around 800 million people. The government distributes subsidized wheat, rice, and other essentials through more than five lakh Fair Price Shops spread across the country. While the system has improved over the years, a large number of rural beneficiaries still face problems accessing basic information about their entitlements [1].

Three core problems stand out when it comes to rural PDS beneficiaries. First, most of them do not know the exact quantity of food grains they are entitled to each month or what price they should be paying. Second, government websites and apps are built for people who can read and operate a smartphone comfortably, which rules out a large portion of rural users. Third, almost all these digital tools are in English,

while the majority of rural beneficiaries in states like Uttar Pradesh, Bihar, Madhya Pradesh, and Rajasthan primarily speak Hindi [2].

At the same time, WhatsApp has become the most commonly used app in rural India, with over 500 million active users in the country. People use it daily to send messages, photos, and voice notes, which means they are already familiar with its interface. This makes WhatsApp a strong candidate for delivering government information to people who might not be comfortable using a dedicated app or website [8]. Prior work has shown that WhatsApp-based tools have been used successfully for health, agriculture, and financial services in rural settings [9].

Keeping this in mind, we built Sahi-Ration, a system where a PDS beneficiary simply sends a photo of their ration card on WhatsApp and receives their full entitlement details back in Hindi, both as text and as an audio message. The system uses a combination of OCR, a large language model, and text-to-speech technology, all connected through an automated workflow. No app download, no login, and no English knowledge is required from the user.

The main contributions of this work are:

- A complete end-to-end WhatsApp-based ration card verification system built specifically for rural PDS beneficiaries.
- A multi-pass OCR pipeline using EasyOCR that can reliably extract ration card IDs from real photographs taken under different lighting and angle conditions.
- Use of LLaMA 3.3-70B via Groq API for generating clear, natural Hindi responses tailored to each beneficiary.
- A Hindi audio delivery module using gTTS so that users who cannot read can still receive and understand their entitlement information.
- An n8n-based workflow that ties all components together with minimal delay and no manual intervention.

The rest of the paper is organized as follows. Section II covers related work. Section III explains the system architecture. Section IV describes the methodology in detail. Section

V presents results and observations. Section VI concludes the paper and discusses future directions.

II. RELATED WORK

A. PDS Digitization in India

The digitization of India's PDS has been a focus area for researchers and policymakers over the past decade. Jemsala and Shiny [1] studied PDS digitalization in Kanniyakumari district and found that while e-POS machines and biometric authentication have helped reduce leakages, rural infrastructure limitations and the digital divide continue to be barriers. Misra and Upadhyay [2] looked at the challenges of upgrading PDS technology and noted that transitioning from manual to automated systems at the Fair Price Shop level remains difficult in many regions. A systematic review of ICT reforms in PDS [3] concluded that Aadhaar-based biometric authentication has shown the most promise among various digital initiatives, but awareness among beneficiaries about these systems is still lacking.

B. OCR for Document Recognition

OCR technology has matured significantly in recent years thanks to deep learning. Nigam et al. [4] surveyed document analysis and recognition methods, showing that deep learning-based OCR models have become the standard for handling real-world document images. EasyOCR [5], an open-source framework developed by JaideedAI, uses a CRNN architecture with ResNet for feature extraction, BiLSTM for sequence modeling, and CTC for decoding. It supports over 80 languages and works without GPU acceleration, which makes it practical for deployment on standard hardware. Vedhavyassh et al. [7] compared EasyOCR and Tesseract for license plate recognition and found EasyOCR to be more effective when an allowlist of characters is used to constrain the output.

C. WhatsApp-Based Systems for Rural Communities

Several researchers have explored WhatsApp as a medium for service delivery in rural India. D'Silva et al. [8] built a WhatsApp bot for citizen journalism in rural areas and reported 218 published stories from 27 users within nine weeks, highlighting how the familiar interface of WhatsApp encourages adoption. Nagar et al. [9] developed ASHABot, a WhatsApp-based chatbot powered by an LLM for community health workers in India. Their results showed that such bots can help users with limited digital skills access important information through a platform they already use. The Odisha government's Ama Sathi initiative [10] integrated over 120 public services into a single WhatsApp chatbot, showing that government services can be delivered at scale through messaging platforms.

D. Large Language Models for Multilingual NLP

LLMs have shown strong performance on multilingual tasks including Hindi text generation. Touvron et al. [11] introduced the LLaMA family of models, demonstrating that open-source models with fewer parameters can perform comparably to

much larger proprietary systems. The Llama 3 series [12] further improved multilingual performance and context handling, making it well suited for generating natural language responses in Indian languages. Groq's hardware-accelerated inference platform makes it possible to use these models in near-real-time applications like WhatsApp bots.

E. Research Gap

While PDS digitization, OCR, WhatsApp bots, and LLMs have each been studied individually, no prior work has combined all four into a single system for ration card verification. Current PDS digital solutions require physical presence, internet literacy, or English proficiency. Sahi-Ration addresses this gap by building a fully automated, Hindi-language, photo-based verification system that works entirely within WhatsApp.

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