

Enabling Intelligent Cooking by Leveraging Al for Food Classification for a Leading

# Smart Oven Nanufacturer

### Customer **Scenario**

The client, a leading manufacturer of smart ovens, sought to enhance their product's capabilities by incorporating AI for intelligent cooking. The oven utilizes a camera to capture images of food placed inside, which are then processed by a Food Recognition & Classification application to identify and classify the food items.

### Business Challenge or Problem

The client encountered several significant challenges in their endeavor. Foremost was the necessity to distinguish a vast array of food items, necessitating extensive image labeling to train a deep learning model. This process proved both time-intensive and costly. Additionally, two key challenges emerged in the user experience domain. Firstly, the limited cooking knowledge among users posed a significant obstacle, as many lacked expertise in cooking techniques, ingredient combinations, and optimal cooking temperatures, restricting their ability to effectively utilize the oven's features. Secondly, the complexity of controls posed a considerable hurdle. Smart ovens typically feature intricate control interfaces encompassing touchscreens, mobile apps, and voice commands. Such complexity may overwhelm users, particularly those who are not tech-savvy, rendering the oven's functionalities difficult to navigate and exploit to their fullest potential.

### Solution

To effectively address the client's challenge of accurately identifying a diverse range of food items without extensive image labeling, we strategically leveraged the deployment of a Large Multi-Model (CogVLM). This model, boasting 10 billion visual parameters and 7 billion language parameters, was a potent open-source visual language model (VLM), adept at supporting image comprehension and facilitating multi-turn dialogue. Our approach involved utilizing the CogVLM by accessing its API, acquired subsequent to deploying the model. Through this API, we passed both the text prompt and the image requiring recognition, enabling us to obtain valuable inferences. Furthermore, we fine-tuned the model using our custom food image dataset, employing the fine-tuning API to enhance accuracies. By integrating the CogVLM, our client achieved zero-shot object detection capabilities, enabling their models to identify objects not explicitly encountered during training. This expanded their recognition scope beyond predefined classes, significantly enhancing their overall capabilities. This feat was accomplished through techniques like semantic embeddings and attribute-based representations, which imbued the model with a deeper understanding of object relationships. Our implementation also substantially reduced the time and resources required for model training, thus optimizing efficiency and performance.

We also implemented intelligent cooking based on AI, which provided users with a solution that guided them through the cooking process. By leveraging advanced algorithms and culinary knowledge, our system could suggest appropriate cooking recommend ingredient techniques, combinations, and set optimal cooking temperatures. This ensured that users could achieve delicious and satisfying results with their smart ovens regardless of their culinary expertise. Additionally, regarding the complex control interfaces, our system simplified the cooking process user-friendly intuitive and through interactions, allowing users to effortlessly navigate through various features and settings. Whether through voice commands, touchscreen gestures, or mobile app interactions, our intelligent cooking solution ensures that users can easily control and customize their cooking experience, maximizing convenience and usability.



Leveraging Replicate for model deployment and management provided the necessary infrastructure and tools for versioning, deployment, and monitoring while utilizing Azure Kubernetes Service (AKS), which ensured scalable and reliable hosting for the custom application. Azure services such as Blob Storage, Event Hubs, Data Lake, Databricks, Data Factory, SQL, Functions, Monitor, Application Insights, Reporting Services, and PowerBI formed a comprehensive ecosystem for developing, deploying, and managing Al-driven solutions effectively.

The solution demonstrated a commitment to Responsible AI principles by leveraging advanced AI technologies to enhance the cooking experience while prioritizing data privacy and customer safety. Measures such as automatic retraining of models based on continuous monitoring contributed to maintaining model accuracy and relevance over time, ensuring that the system evolves responsibly with changing data dynamics. Additionally, Azure's robust security features and compliance certifications helped safeguard sensitive data, providing customers with peace of mind regarding data privacy and security. The AI-driven features enhance the user experience by providing personalized cooking settings and real-time dish progress monitoring. Ultimately, the incorporation of AI technologies gave the client a competitive advantage in the smart oven industry, positioning them as an innovator with unique functionalities that set their product apart from competitors.

### The solution leverages various **Technologies** as follows:

- **Replicate:** Used for deploying and managing the CogVLM model. Replicate simplifies model deployment by providing infrastructure and tools for versioning, deployment, and monitoring.
- Azure Kubernetes Service (AKS): Hosts the custom application developed using Python Flask, facilitating scalable and reliable hosting.
- Azure Blob Storage: Stores pre-processed data and associated files.
- Azure Event Hubs / Azure Data Lake: Ingests data for model training.
- Azure Databricks / Azure Data Factory: Prepares and pre-processes data, enabling efficient data exploration, analysis, and feature engineering.
- Azure SQL: Stores pre-processed data.
  - Azure Functions: Deploy models.
  - Azure Monitor and Azure Application Insights: Monitor model performance and application health.
  - Azure Reporting Services / PowerBI: BI and reporting.

The integration of these Microsoft services provided a comprehensive ecosystem for developing, deploying, and managing Al-driven solutions effectively.



## The solution offers several benefits and business impacts, including:

#### **Cost Reduction**



By employing a Large Multi Model (CogVLM) for zero-shot object detection, the client eliminates the need for extensive image labeling and training, reducing both time and costs associated with model development.

#### **Increased Productivity**



The streamlined process of food recognition and classification enables faster and more accurate identification of food items, enhancing overall productivity in cooking operations.

#### **Enhanced User Experience**



By leveraging AI-driven capabilities, such as suggesting cooking settings based on previous patterns and real-time monitoring of dish progress, the smart oven delivers a personalized cooking experience tailored to user preferences.

#### **Competitive Advantage**



The incorporation of AI technologies positions the client as a leader in the smart oven industry, offering innovative features and functionalities that differentiate their product from competitors.



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