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AI-Powered Smart Shopping Seamless Personalization

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ABSTRACT: The Intelligent Retail Experience aims to transform traditional shopping by integrating cutting-edge technologies such as facial recognition, voice assistance, an automated payment system. Upon entering the store, customers are prompted to register their personal information, including email, phone number, and facial data, ensuring a seamless and personalized shopping journey. For returning customers, the system quickly retrieves their information to facilitate easy access. Inside the store, a voice assistant is available to help customers navigate the aisles, find desired products, and provide real-time pricing based on quantity and weight. Once a product is selected, the system updates the customer account with the purchase details. Upon completing the shopping, the system generates an electronic bill and a QR code, which is sent to the customer email for convenient payment. An email verification step further enhances security during store entry. This concept streamlines the shopping experience, offering convenience, security, and personalization, all while enabling a smooth transition from shopping to payment.

KEYWORDS: facial recognition, voice assistance, automated payment system, personal information, registration, email, phone number, facial data, purchase tracking, electronic bill, QR code, email notification personalization, shopping automation.

I.INTRODUCTION

In today's fast-paced world, customers demand convenience, personalization, and efficiency in every aspect of their shopping experience. Traditional retail systems often fall short in meeting these expectations, leaving room for improvement in customer satisfaction and store operations. The Intelligent Retail Experience concept addresses these needs by integrating advanced technologies such as facial recognition, voice assistance, and automated billing into the shopping process. This innovative system ensures that customers receive a seamless, efficient, and personalized shopping experience from the moment they step into the store. With this system, customers no longer need to manually check out or search for products. By simply registering their details, including email, phone number, and facial data, they can access their personalized shopping profile upon entry. Returning customers benefit from swift data retrieval, eliminating the need to input details again. Inside the store, the voice assistant acts as a helpful guide, providing real-time product information, prices based on quantity and weight, and recommendations based on previous, or preferences. This instant access to information enhances decision-making and makes the shopping process smoother and faster.

The integration of AI in smart shopping extends beyond e-commerce platforms to physical retail stores through smart shelves, automated checkouts, and AI-powered inventory management systems. This fusion of online and offline shopping creates a seamless omnichannel experience in store. Furthermore, AI-driven analytics help businesses gain deeper insights into consumer behaviour, enabling retailers to optimize pricing strategies, manage inventory efficiently, and enhance customer loyalty. As AI continues to evolve, smart shopping will become even more intuitive, ensuring that customers find what they need with minimal effort while retailers achieve increased sales and improved customer satisfaction. Seamless personalization is at the heart of AI-powered smart shopping. Unlike traditional retail methods that rely on generalized marketing strategies.

II. PROPOSED SYSTEM

The proposed system, the Intelligent Retail Experience, aims to revolutionize the shopping process by integrating advanced technologies such as facial recognition, voice assistance, and automated billing. Upon entering the store, customers will be prompted to register their details, including email, phone number, and facial data. This registration process ensures that both new and returning customers can quickly access their personalized shopping profiles. For returning customers, the system will automatically retrieve their information using facial recognition, streamlining entry and improving security. Inside the store, the voice assistant, powered by Natural Language Processing (NLP), will allow customers to inquire about product availability, pricing, and specifications. Customers can interact with the system using voice commands, and the assistant will provide real-time responses, ensuring a smoother and more efficient shopping experience. If a product is unavailable, the voice assistant will immediately inform the customer, saving time and preventing frustration. Once the customer selects the desired products, the system will automatically update their account with purchase details, including the product's weight and price. At checkout, there will be no need for manual processing, as the system generates an electronic bill and a QR code, which is sent directly to the customer's email. This allows for seamless payment via the QR code, reducing wait times and enhancing convenience. This project focuses solely on the software development aspect, serving as a prototype for the Intelligent Retail Experience without involving any hardware components.

III. USER REQUIREMENTS

1. Hardware used:
 - Processor - Intel
 - Speed - 1.1 GHz
 - RAM - 8 Gb
 - Hard Disk - 500 GB
2. Software used:
 - Operating System - Windows 7/8/10
 - Front End - Html, Css
 - Scripts - Python Language
 - Tool - Python IDLE

IV. IMPLEMENTATION AND RESULTS

List of modules:

- User Registration module
- Voice Assistance and payment module
- Facial Recognition using Resnet Module
- Natural Language processing Technology

User Registration module:

The User Registration Module is responsible for registering customers when they enter the store. This module integrates both facial recognition and email registration into a single, seamless process. New customers will provide their email addresses and facial data, which are stored securely in the system. Returning customers will have their profiles automatically retrieved using facial recognition technology, ensuring fast and secure entry. This registration module is key to personalizing the shopping experience and providing a smooth onboarding process for both new and existing customers.

Voice Assistance and payment module:

The Voice Assistance and Payment Module enhances the shopping experience by providing customers with an intuitive, hands-free interface. Using Natural Language Processing (NLP) techniques, the voice assistant helps customers inquire about product availability, pricing, and specifications, making their interaction with the system more efficient. Additionally, this module handles payment processing by automatically generating a digital bill and sending a QR code

to the customer's email for seamless payment. By integrating voice assistance and payment functionality, this module simplifies the purchasing process and minimizes wait times at checkout.

Facial Recognition using Resnet Module:

The Facial Recognition Using ResNet Module is designed to identify customers based on their facial features. Using the ResNet deep learning model, the system accurately processes facial data to recognize returning customers and retrieve their personalized information. This ensures a quick and secure customer entry into the store, eliminating the need for manual check-ins. The module improves both security and customer experience, making the entire shopping journey more personalized and efficient by automatically linking the customer to their profile upon entry.

Natural Language processing Technology:

Voice Assistance Using NLP Module provides an interactive, voice-driven interface for customers to query the system about various aspects of the store, such as product availability, prices, and specifications. Powered by advanced Natural Language Processing techniques, the module ensures that the system accurately understands and responds to voice commands in real-time. It streamlines product discovery and enhances the customer's shopping experience by allowing them to browse and gather information without having to rely on physical search or store attendants. This module serves as a key interface for customers to interact with the system using voice commands.

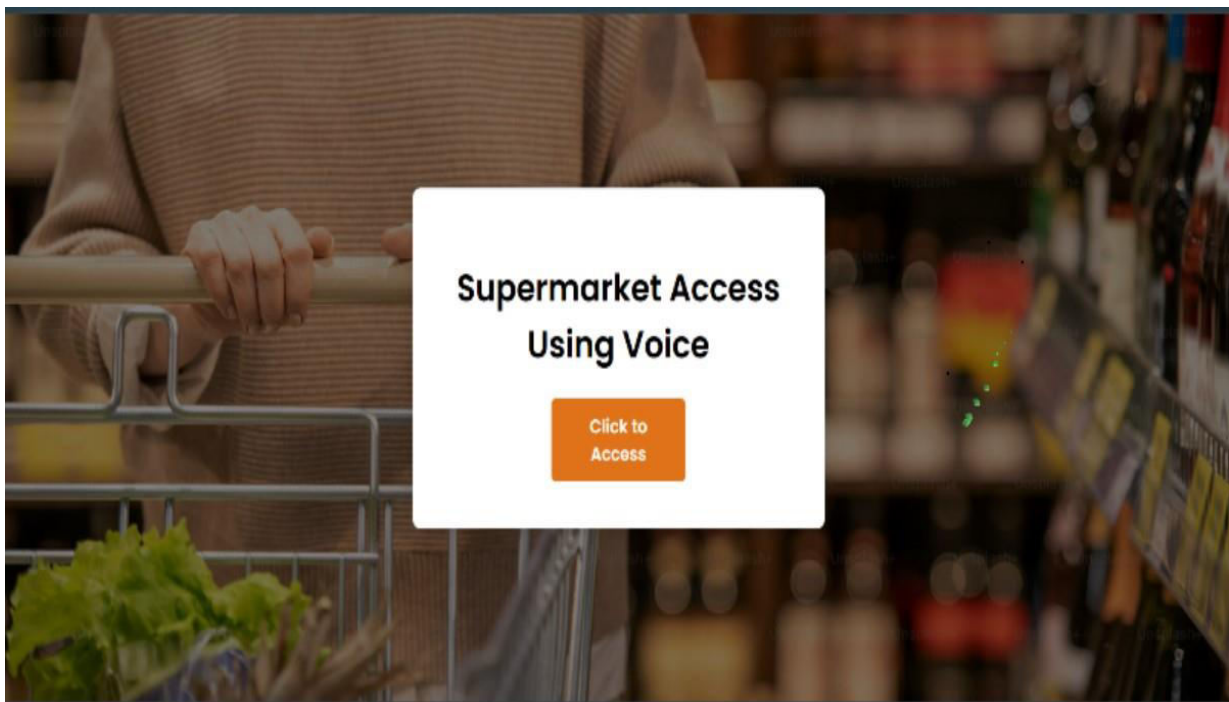


Fig.1 Home page

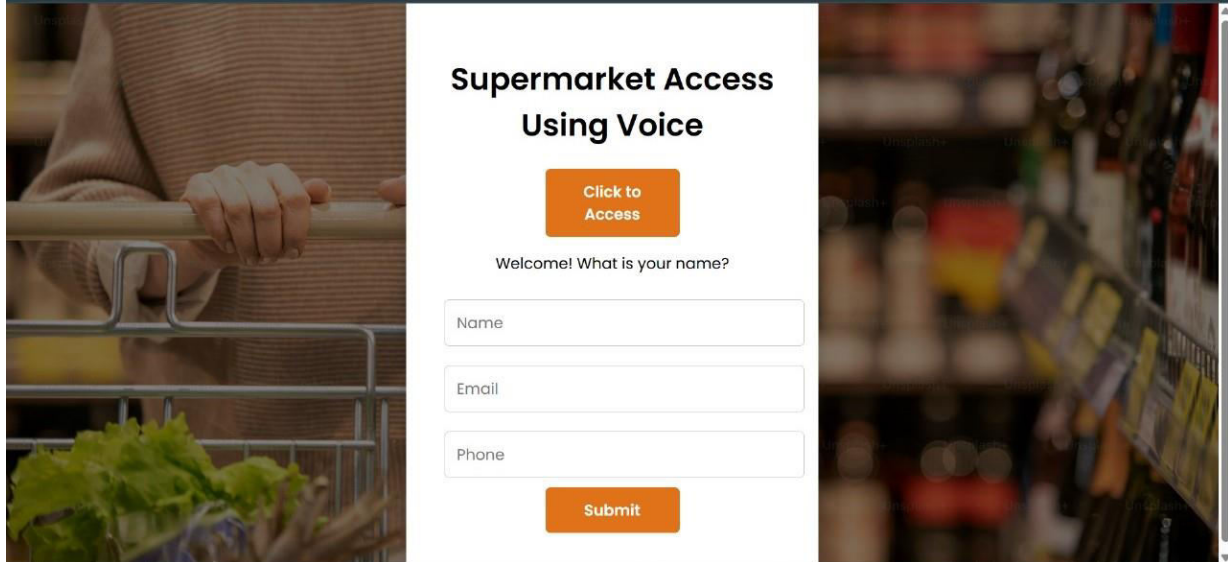


Fig.2 Registration form



Fig.3 Supermarket bill

V.LITERATURE SURVEY

In the paper [1],authored by SEHRISH MALIK 1 AND DOHYEUN KIM.” A Hybrid Scheduling Mechanism Based on Agent Cooperation Mechanism and Fair Emergency First in Smart Factory”. Smart factory also known as smart manufacturing is an emerging field with the revolution of industry 4.0. With the help of all these concepts, the smart factory integrates the manufacturing assets and represents industrial networks. In this paper, we focus on integrated solutions for smart factory concerns; by proposing an efficient task management mechanism based on an efficient and resource-aware scheduling scheme named as ACM-FEF. The scheduling algorithm used for the efficient task management is hybrid of the two scheduling approaches as agent cooperation mechanism (ACM) and fair emergency first (FEF) scheduling scheme.

In the paper [2],authored by MIKEL CELAYA-ECHARRI, LEYRE AZPILICUETA, VICTORIA RAMOS, PEIO LOPEZ-ITURRI AND FRANCISCO FALCONE .” Empirical and Modeling Approach for Environmental Indoor RF-EMF Assessment in Complex High-Node Density Scenarios: Public Shopping Malls Case Study” This work provides

an intensive and comprehensive in-depth study from an empirical and modeling approach of the environmental radiofrequency electromagnetic fields (RF-EMF) radiation exposure in public shopping malls, as an example of an indoor high-node user density context aware environment, where multiple wireless communication systems coexist. For that purpose, current personal mobile communications (2G-5G FR 1) as well as Wi-Fi services (IEEE 802.11n/ac) have been precisely analyzed in order to provide clear RF-EMF assessment insight and to verify compliance with established regulation limits.

In the paper [3], authored by LEI YAO, TIANHAO LI, RUI TONG, KAI WANG, AND LINGXIANG ZHANG. "Radar Self-Following Shopping Cart Based on Multi-Sensor Fusion". Long queues of people waiting for a settlement in global shopping supermarkets are bustling with traffic. In order to further improve operating efficiency and reduce the cost of manual operation of the supermarket, this article proposes a multi-sensor integration shopping cart system, which mainly includes image recognition, radar self-following technology and road patrol. The improved SIFT algorithm effectively identifies a variety of commodities.

In the paper [4], authored by MOBEEN SHAHROZI, MUHAMMAD FAHEEM MUSHTAQ 2, MAQSOOD AHMADI, SALEEM ULLAH 1, ARIF MEHMOOD 3, AND GYU SANG CHOI. "IoT-Based Smart Shopping Cart Using Radio Frequency Identification". The modern age of technology in which most of the customer needs to wait in the supermarket for shopping because it is a highly time-consuming process. A huge crowd in the supermarket at the time of discount offers or weekends makes trouble to wait in long queues because of a barcode-based billing process. In this regard, the Internet of Things (IoT) based Smart Shopping Cart is proposed which consists of Radio Frequency Identification (RFID) sensors, Arduino microcontroller, Bluetooth module, and Mobile application. RFID sensors depend on wireless communication. One part is the RFID tag attached to each product and the other is RFID reader that reads the product information efficiently.

In the paper [5], authored by JIANQIANG XU1, ZHUJIAO HU2, ZHUO ZOU, LIZHENG LIU, AND LIRONG ZHENG. "Design of Smart Unstaffed Retail Shop Based on IoT and Artificial Intelligence". Unstaffed retail shops have emerged recently and been noticeably changing our shopping styles. In terms of these shops, the design of vending machine is critical to user shopping experience. The conventional design typically uses weighing sensors incapable of sensing what the customer is taking. To analyze multiple target features of commodities, the SSD (300 × 300) algorithm is employed; the recognition accuracy is further enhanced by adding sub-prediction structure. Using the data set of 18, 000 images in different practical scenarios containing 20 different type of stock keeping units, the comparison experimental results reveal that the proposed SSD (300 × 300) model outperforms than the original SSD (300 × 300) in goods detection, the mean average precision of the developed method reaches 96.1% on the test dataset, revealing that the system can make up for the deficiency of conventional unmanned container.

VI. ARCHITECTURE DIAGRAM

6.1 overview

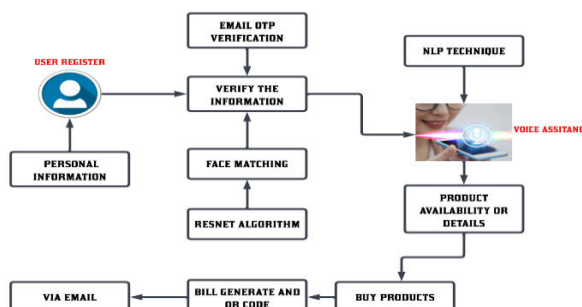


Fig.4 Architecture Diagram

The Intelligent Retail Experience system begins with user registration, where customers provide personal information, including email, phone number, and facial data. To enhance security, an email OTP verification process is conducted, followed by face matching using the ResNet algorithm. Returning customers can bypass registration as their details are retrieved from the database. Once inside the store, an NLP-powered voice assistant helps users navigate aisles, find products, and obtain real-time pricing based on quantity and weight. When a product is selected, the system updates the customer's account with the purchase details. At checkout, an electronic bill and QR code are generated and sent via email, allowing seamless and secure payment processing. This streamlined approach integrates facial recognition, voice assistance, and automated billing, enhancing convenience, security, and personalization in the shopping experience.

6.2 USECASE DIAGRAM

The Intelligent Retail Experience revolutionizes traditional shopping by incorporating advanced technologies like facial recognition, voice assistance, and automated payment systems. The process begins with user registration, where customers provide personal details such as email, phone number, and facial data. The ResNet Algorithm is then employed for face matching, ensuring secure authentication. To further enhance security, an email OTP verification step is implemented, allowing the system to verify user identity before granting access. Once inside the store, the NLP-based voice assistant assists customers by guiding them through aisles, helping them find products, and providing real-time pricing details. As users select products, the system automatically updates their account with purchase details. Upon completing the shopping process, an electronic bill is generated along with a QR code, which is then sent to the customer's email for seamless payment. This automated and personalized shopping experience not only enhances convenience but also ensures security and efficiency, streamlining the transition from product selection to payment.

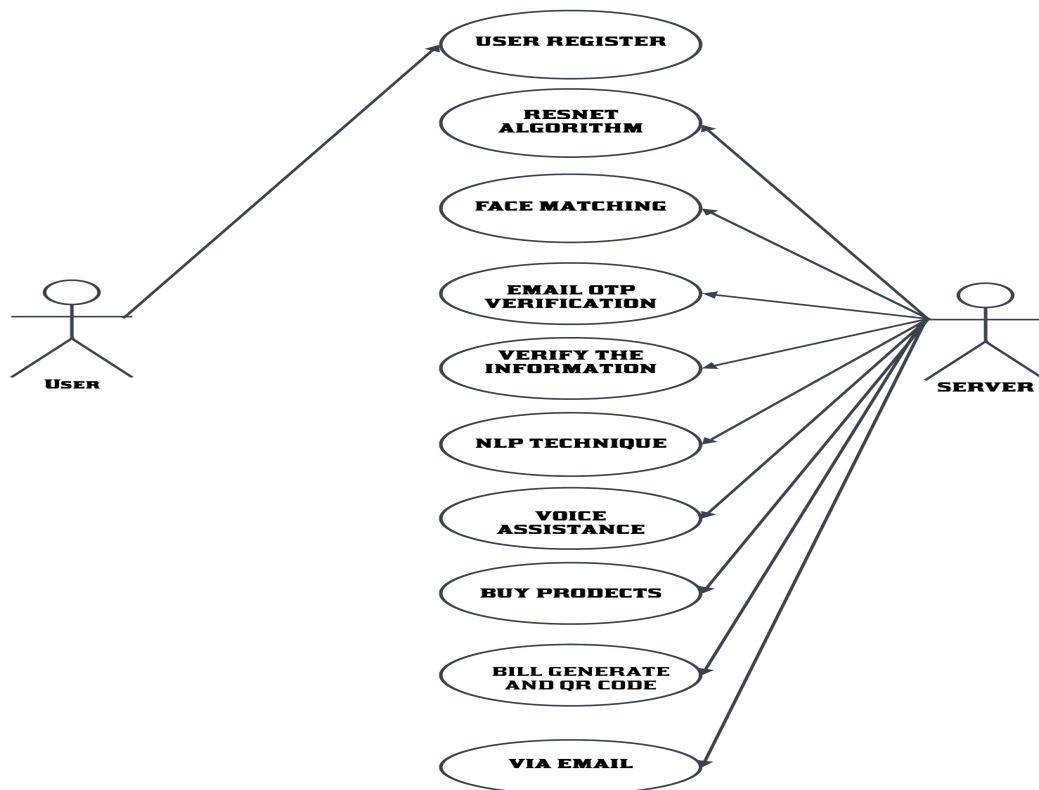


Fig.5 Usecase Diagram

6.3 Activity Diagram

The Intelligent Retail Experience streamlines shopping by integrating facial recognition, voice assistance, and automated payments. The process begins with user registration, where personal details and facial data are collected and

verified using the ResNet algorithm and face matching. For security, an email OTP verification is required before access is granted. Inside the store, an NLP-powered voice assistant helps users find products and provides real-time information. Selected items are automatically recorded in the system, and upon checkout, a bill with a QR code is generated and sent via email for seamless payment. This approach ensures efficiency, security, and a personalized shopping experience.

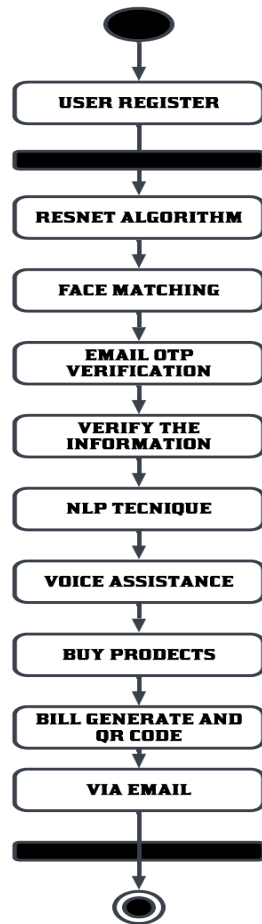


Fig.6 Activity Diagram

6.4 Data Flow Diagram

The Intelligent Retail Experience is structured into multiple levels to ensure a secure and seamless shopping process. At Level 0, users begin by registering their personal details, including facial data, which is processed using the ResNet algorithm for facial recognition and face matching. Moving to Level 1, the system enhances security with email OTP verification, followed by information verification and NLP techniques to facilitate user interaction. Finally, at Level 2, an NLP-powered voice assistant guides users in-store, helping them select products and updating their purchases in real time. Upon checkout, the system generates a bill and QR code, which is then sent via email for a seamless and efficient payment process. This structured approach enhances security, convenience, and personalization in retail shopping.

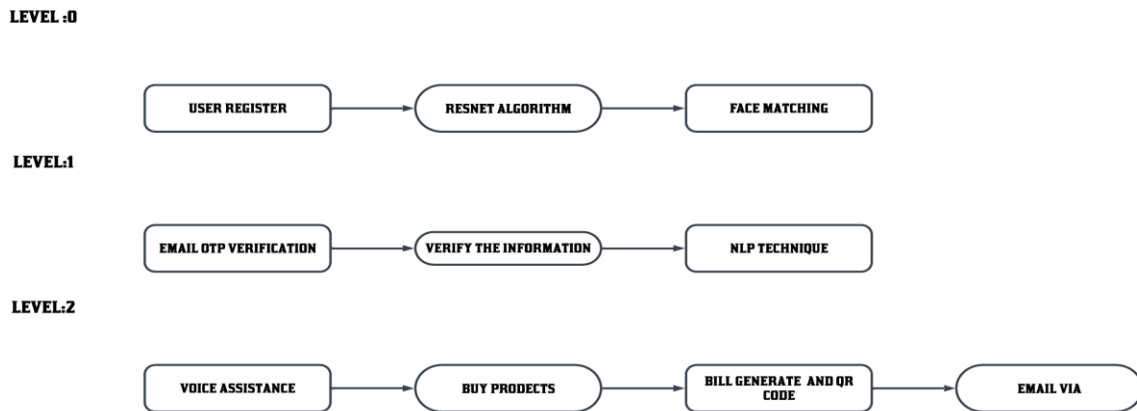


Fig.7 Data flow diagram

VII. PROPOSED SYSTEM ALGORITHM

ResNet (Residual Network) is a powerful and widely adopted deep learning architecture, first introduced in the paper "Deep Residual Learning for Image Recognition" by Kaiming He et al. in 2015. The primary aim of ResNet is to solve the problem of training very deep neural networks. As networks deepen, they tend to suffer from performance degradation due to vanishing gradients, poor convergence, and increased complexity, but ResNet overcomes these challenges with its innovative architecture. It introduces the concept of residual learning, which helps networks achieve much deeper layers while maintaining efficient training. ResNet has been a breakthrough in the field of computer vision, winning the 2015 ImageNet competition with outstanding performance. Since its introduction, ResNet has become a foundational architecture for various applications, from image recognition to more advanced tasks like object detection, segmentation, and even natural language processing.

Core Idea: Residual Learning

Before ResNet, increasing the depth of neural networks was thought to improve their capacity to model complex data. However, adding more layers to a deep network also caused training difficulties. When networks become very deep, it is hard to learn effective representations due to the vanishing gradients problem. This happens because gradients used in backpropagation can become extremely small, making it difficult for weights in earlier layers to change during training. ResNet tackles this problem by introducing skip connections or residual connections, which are short paths that bypass one or more layers. In a residual network, the output of each layer is added to the output of the previous layer, creating what is known as a residual block. The key idea of residual learning is expressed mathematically as: $y = F(x, \{W_i\}) + x$ where:

- x is the input to the residual block,
- $F(x, \{W_i\})$ is the output of the residual block after applying a series of transformations (convolutions, activations, etc.),
- y is the final output of the block.

Here, instead of learning the direct mapping $y = F(x)$, the network learns the residual function $F(x)$ that is added to the input x . This makes it easier for the network to learn identity mappings (i.e., when the input and output are the same), which helps prevent the performance degradation associated with deep networks.

Architecture of ResNet:

The ResNet architecture consists of a stack of residual blocks, and there are different variants of ResNet depending on the number of layers. Common variants are ResNet-18, ResNet-34, ResNet-50, ResNet-101, and ResNet-152, where the numbers represent the total number of layers in the network. A standard residual block in ResNet typically consists of:

1. Two convolutional layers (often 3x3 filters)
2. Batch normalization after each convolution to stabilize learning.
3. ReLU activation functions (Rectified Linear Units)
4. Skip connections that bypass the convolutional layers and directly add the input to the output.

The deeper ResNet versions, such as ResNet-50, ResNet-101, and ResNet-152, use more sophisticated residual blocks with bottleneck structures. A bottleneck residual block has three layers:

- A 1x1 convolution to reduce dimensionality,
- A 3x3 convolution for the core processing,
- A 1x1 convolution to restore dimensionality.

This bottleneck structure helps improve computational efficiency by reducing the number of parameters and operations, making it feasible to train deeper networks without excessive computational cost.

ResNet power:

- 1) Avoiding vanishing gradients: The introduction of skip connections allows the gradients to flow more easily through the network during backpropagation. This ensures that gradients remain large enough for earlier layers to update their weights effectively.
- 2) Residual learning is easier: Instead of learning a direct mapping, the network learns the residual, which is easier to optimize. This leads to better performance, especially as the network depth increases.
- 3) Improved convergence: Deep residual networks are much easier to train compared to traditional deep networks. ResNet facilitates faster convergence and reduces training time.
- 4) Deeper networks generalize better: With residual connections, the network can reach much deeper architectures without overfitting. This allows the model to capture more complex patterns in the data.
- 5) Building blocks for transfer learning: ResNet's architecture has become a standard backbone for transfer learning, where pretrained networks on large datasets like ImageNet are fine-tuned for specific tasks. The deep network and efficient learning make it an ideal candidate for feature extraction in other domains, such as medical imaging or video analysis.

VIII.CONCLUSION

The Intelligent Retail Experience project presents a revolutionary approach to modernizing the shopping process through the integration of cutting-edge technologies such as facial recognition, voice assistance, and automated payment systems. By combining these technologies into a cohesive system, the project enhances the overall shopping experience, offering customers a seamless, efficient, and personalized journey from registration to checkout. The use of facial recognition ensures quick and secure entry for returning customers, while the voice assistance module, powered by Natural Language Processing (NLP), provides an intuitive, hands-free way to inquire about products and pricing. The automated billing and payment system further streamlines the process, reducing wait times and increasing convenience. The project not only simplifies store operations but also offers valuable insights through data collection and analytics, enabling better inventory and customer management.

IX.FUTURE SCOPE

In the context of the Intelligent Retail Experience, feature extraction is a crucial process that enables the system to gather, analyse, and leverage key data from a variety of sources to enhance customer experience, personalize services, and ensure security. At the core of this process, facial recognition technology extracts unique features from a customer's face, such as the distance between facial landmarks, the shape of the nose, and the contour of the jaw, creating a distinctive "face template." This template is compared with stored profiles to verify identity quickly and securely as the customer enters the store. In addition to facial features, voice assistance plays a pivotal role in this experience, where voice commands are processed to extract acoustic and phonetic features. These features include tone, pitch, and speech patterns, which are analysed to understand and respond to customer queries, navigate aisles, provide pricing information, and even suggest products based on previous purchases. The system's ability to interpret and process these voice features ensures a seamless interaction between the customer and the store. Furthermore, automated payment systems rely on feature extraction from product data—such as price, quantity, and weight—along with customer

profiles to ensure accurate billing. The real-time tracking of purchases allows the system to automatically update the shopping cart and generate an electronic bill. Additionally, personalized features are extracted from customer behaviour, such as their past purchase history or shopping preferences, allowing the system to tailor product suggestions and offer discounts that align with individual tastes. By combining all these features—biometric data, voice commands, purchase history, and real-time actions—the Intelligent Retail Experience can deliver a highly personalized and secure shopping environment. Feature extraction is thus a critical component in ensuring that the system can respond intelligently and accurately to customer needs, all while providing a smooth transition from shopping to payment.

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