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AI Based Smart Retail Checkout System with Automated Product Detection and Customer Assistance Chatbot

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ABSTRACT:

Traditional retail checkout systems often involve long queues, manual billing, and limited customer assistance. This paper presents an AI-based Smart Retail Checkout System that automates product detection, tracking, and billing using computer vision. The system uses YOLOv11 for product detection, DeepSORT for object tracking, and OpenCV for real-time video processing. A React-based frontend and Flask backend are integrated with an SQLite database for managing products and transactions. Additionally, an NLP-based chatbot using TF-IDF and Logistic Regression is included to provide customer assistance and answer common retail-related queries. The proposed system aims to reduce checkout time, minimize manual effort, and improve the overall shopping experience through integrated AI-based automation.

Introduction:

Traditional retail checkout systems require customers to wait in queues and depend on manual product scanning and billing, which can increase checkout time and human effort. With the advancement of Artificial Intelligence (AI) and Computer Vision, retail operations can be automated to provide faster and more efficient checkout experiences. This paper proposes an AI-based Smart Retail Checkout System that detects and tracks products using YOLOv11 and DeepSORT, enabling automated cart management and billing. The system also integrates an NLP-based chatbot to assist customers with common queries and provide information about the checkout process. By combining computer vision, machine learning, and chatbot technology, the proposed system aims to reduce manual intervention, improve checkout efficiency, and enhance the overall customer experience.

Problem Statement:

Traditional retail checkout systems involve long queues, manual product scanning, billing delays, and limited customer assistance. These challenges increase waiting time and require significant human intervention.

Objectives:

- Automate product detection and tracking.
- Generate bills with minimal manual intervention.
- Reduce checkout time and human effort.
- Provide customer assistance through an AI-based chatbot.
- Integrate computer vision and machine learning into a unified retail system.

Proposed System:

The proposed system is an AI-based Smart Retail Checkout System that uses computer vision to detect and track products and automate the checkout and billing process. An integrated chatbot provides customers with assistance and answers common retail-related queries.

Methodology:

The system uses **YOLOv11** for product detection, **DeepSORT** for object tracking, and **OpenCV** for real-time image and video processing. **React** is used for the frontend, **Flask** for backend services, and **SQLite** for data management. The chatbot uses **TF-IDF** for text feature extraction and **Logistic Regression** for intent classification.

Chatbot Module:

The chatbot is an NLP-based customer assistance module that understands common customer queries and provides relevant responses. It uses TF-IDF to convert text into numerical features and Logistic Regression to classify the user's intent.

System Architecture:

The system consists of a React frontend, Flask backend, computer vision module, chatbot module, SQLite database, and automated billing module. The computer vision module detects and tracks products, while the chatbot handles customer queries. The backend coordinates these modules and manages product and transaction data.

Results:

The developed prototype successfully demonstrates automated product detection, object tracking, cart management, and billing. The integrated chatbot provides customer assistance through intent-based responses. The system demonstrates the potential of combining computer vision and NLP to improve retail checkout efficiency and customer experience.

Advantages:

- Reduces checkout time and customer waiting.
- Minimizes manual billing and human effort.
- Provides automated product detection and tracking.
- Improves billing accuracy.
- Provides instant customer assistance through the chatbot.
- Integrates computer vision and NLP in a single retail system.

Limitations:

- Product detection is limited to the products used for model training.
- Detection accuracy may be affected by lighting, occlusion, and product placement.
- Different stores may require different product datasets and pricing information.
- Chatbot responses are limited to the intents and queries included in its training data.
- The prototype may require further optimization for large-scale real-world deployment.

Future Scope:

- Support dynamic product databases for different retail stores.
- Improve product detection accuracy using larger and diverse datasets.
- Integrate real-time inventory and stock management.
- Add digital payment and receipt generation.
- Enhance the chatbot with larger datasets and voice-based interaction.
- Deploy the system on cloud platforms for scalable real-world use.

Conclusion:

The proposed Smart Retail Checkout System demonstrates how AI, computer vision, and NLP can be combined to automate retail checkout operations. YOLOv11 and DeepSORT enable product detection and tracking, while the integrated chatbot provides customer assistance. The system reduces manual effort and checkout time while improving the overall shopping experience. The prototype provides a foundation for developing a more scalable and intelligent automated retail solution.

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