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Next-Gen Blend of Retail & Online Shopping

A Product from the Customer Experience Center,
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by
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Abstract

In an attempt to hop on to the cashierless bandwagon and cater a seamless and personalized shopping experience to the time-crunched and savvy shoppers, we came up with an Artificial Intelligence (AI) based Retail Marketing Intelligence system which provides a stupendous automated and personalized shopping experience based on past online and in-store shopping spree. In the digital marketing world, where AI bridges the gap between analytics and marketing strategies to engage customers and improve sales turnover, AI technologies are being adopted by both online and offline retail businesses. We are presenting an AI integrated system for brick-and-mortar stores, consisting of Computer Vision based Product Shelf, NLP (Natural Language Processing) based voice-assistant in the form of Kiosk, and Smart Vision based Adboard. The system is intelligent to roll out recommendations and offers on specific products that align to the consumer's interest based on their shopping pattern facilitating both upsell and cross-sell. This personalized shopping experience interests both the consumer and the store owners wherein it caters an individualized experience to the buyer and targeted selling for the retail store owners. This system enables a retailer or marketer to pitch the desired audience and helps in reshaping the marketing spectrum; so, one can create better and more seamless digital marketing strategies.

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1. Introduction

Artificial Intelligence (AI) is an indispensable technology companies can use to extract important insights and cutting-edge strategies from troves of data. The task of sifting through and analyzing huge chunks of data is feasible today, thanks to modern hardware and the emergence of technologies like AI.

AI for marketing deals with customer data using techniques like machine learning, deep learning, etc., to foresee customer behavior and improve their experience. The way big data has evolved and the advanced analytical solutions possible these days helps marketers target their customers and picture them clearer than ever before. Now equipped with big data insights and state-of-the-art analytics, digital marketers can magnify a campaign's performance and ROI with no manual intervention.

As consumer behavior has changed, we have witnessed a shift in the retail sector from traditional brick-and-mortar stores to a new combination of bricks and clicks. Buyers these days prefer customized shopping that takes their preferences into account and facilitates home delivery.

Over the past few years, the trend has been for brands to expand their horizons by catching new leads, converting them, and expanding their reach and offerings. These new tech-savvy bricks-and-clicks establishments not only sell through their stores or websites but integrate these into an interactive single retail strategy that provides a very customized customer experience.

Today, the retail industry is in the midst of a radical transformation. Rapidly evolving consumer habits, fast-changing technologies and challenging competitive dynamics will drive retailers to push the envelope in every possible way. If retailers want to stay ahead of the curve, they must innovate, transform and lead the change.

In this paper, we propose a next-gen blend retail and online shopping system as a one-of-a-kind AI marketing solution to boost marketing campaign performances and support advancement in organizational objectives.

2. Retail Marketing Intelligence System

Next-gen blends AI with retail and online shopping systems track consumers' online and in-store activities to help understand buying patterns. This system enables consumers to pick any product from a store, add it to a virtual cart, and check out anytime via a voice-assisted kiosk. This saves time waiting in line and provides a seamless shopping experience.

For the marketer, it tracks shopping activities both online and in-store to understand consumer buying patterns to target the right audience pool for product offers and sales pitches. A detailed description of all the components of the Retail Marketing Intelligence System follows in the next section.

3. Components

The Retail Marketing Intelligence System is formed from interconnections of various AI-based components that are set up at a store. The following are detailed descriptions of each component and its purpose throughout the shopping process:

Ad Board

The advertisement board is usually placed in the vicinity of the retail shop. This ad board can either be a digital board or a traditional board and it comes with a camera to collect facial data to do targeted marketing. The ad board captures the facial data of shoppers showing an interest in the product being advertised. Shoppers who have already given consent for using their facial data are captured for the customized shopping experience. This consent is given at the time of registering a new user either online or in-store.

The facial data is extracted from the camera feed using a Histogram of Oriented Gradients (HOG) feature descriptor. This data is compared to all the customers who have given consent. Once a match is found, the HOG identifies the individual from the list of customers who show an interest in the advertised product.

Smart Product Shelf

The product shelves are like any other shelves in any large store except each shelf is monitored by a dedicated camera. The camera is linked to a series of engines that catch any shopper activity or interaction with an item. The system is smart enough to infer if an item is picked up from the shelf or put back. The system can distinguish one item from a variety of items put up on a shelf and the quantity is accurately registered.

This engine is backed up by a mature Convolutional Neural Network, built on top of a SSD MobileNet v1 CNN pre-trained on a COCO dataset. This CNN uses transfer learning, and after training it for the specific items present on the shelf, results in a highly accurate and robust model.

Checkout Kiosk (Samantha)

The Test Automation phase, where we feel traditional automation techniques are underused the most, is when it comes to maintaining existing test scripts. A lot of improvement is expected with artificial intelligence incorporated into next-generation automation tools.

Below is a list of a few of the challenges every test automation engineer faces while maintaining test scripts during daily regression runs or application updates.

The kiosk is a free-standing structure used to display information or provide a service. In our proposed intelligence system, “Samantha” is an unmanned kiosk consisting of a camera, microphone, and a speaker. It is programmed with software that incorporates Computer Vision (Face Recognition) and Natural Language Processing (NLP) with voice recognition and synthesis, which provides customers with an experience similar to a manned kiosk. The kiosk wakes up when the user says “Samantha” and assists with following tasks:

- Automatic user identification with greeting
- Helps with registration process for the store
- Displays information on the user dashboard
- Handles checkout process and payments
- Provides product information, offers, and location in the store

Under the hood of the kiosk, the following frameworks/technologies are used:

1. Speech Recognition library extracts text from the user’s voice, which is transferred to a Rasa server.
2. Rasa AI conversational framework is used to interpret the intent of the user’s speech and to respond back using a NLP core + dialogue management system built into the framework. The Rasa engine/server can be trained for a specific domain after feeding domain-specific terminology to the engine.
3. Operating system inbuilt voice synthesis plugin enables the kiosk to prompt back to the user.

This kiosk gives seamless service to the user that is quite similar to a manned kiosk.

User Dashboard

As the name suggests, this is a graphical user interface that shows information to the user in an organized way. In our case, it displays a virtual cart while the customer shops in the store, as shown in Fig 1.

It consists of the following information sections:

1. User information such as name, mobile number, user picture, etc.
2. Virtual cart status showing items taken from the shelf by the user along with item information such as quantity and rate.

The user dashboard is developed using React JS. The dashboard's purpose is to show the user's shopping activities while inside the store.

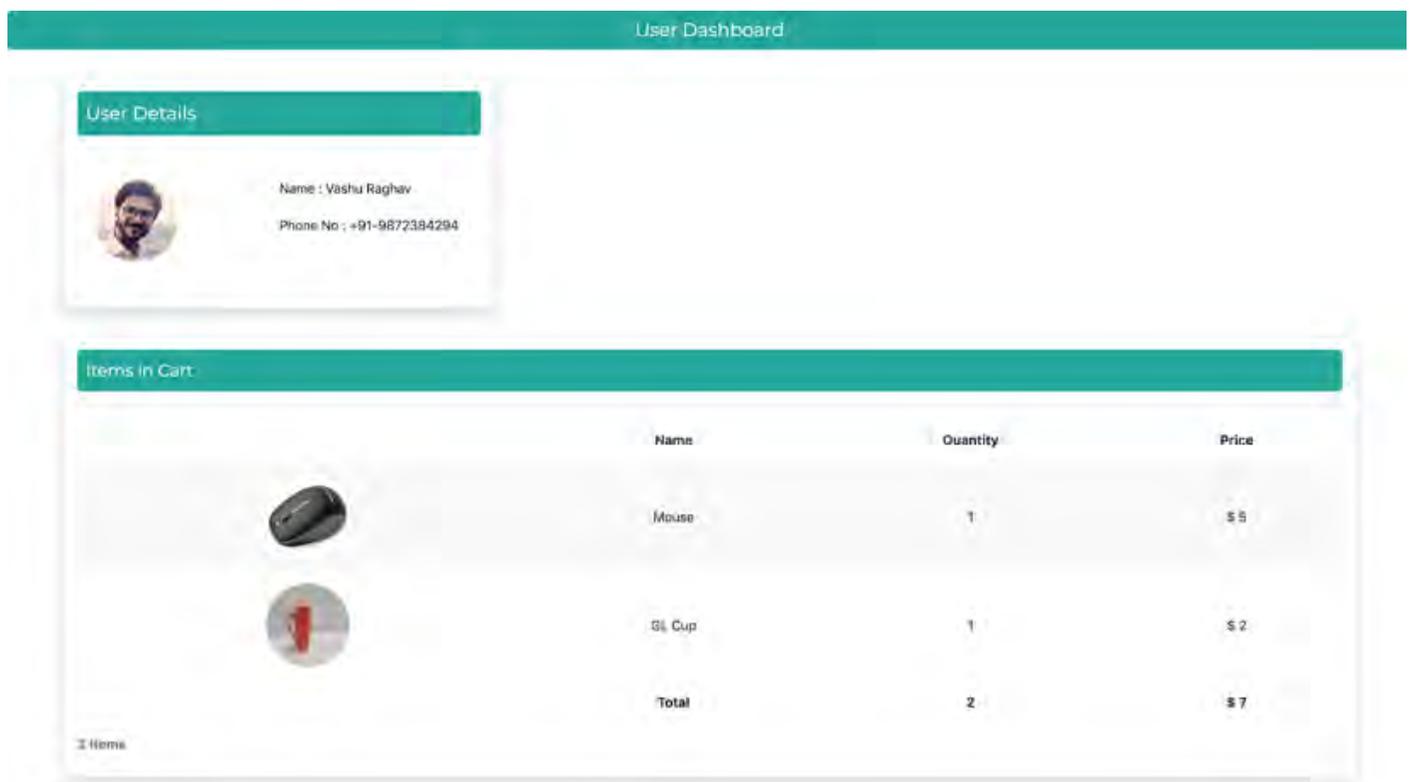


Fig 1: User Dashboard

Central Engine

The central engine is the heart and mind of the entire system. It connects all the entities together and facilitates data transfer through a dedicated server. The central engine is responsible for managing the lead database and sending out personalized promotional offers to customers based on the lead score it manages. It is also responsible for carrying out user dashboard updates after sensing a customer interaction with a shelf.

Role of the Central Engine in Managing Online and Offline Activities

The central engine plays a very important role in devising intelligence based on online activities and in-store interactions.

After recognizing a customer looking at an ad board and showing interest in an advertised product, it sends out a personalized mobile message to the registered mobile number, encouraging the user to visit the store and make a purchase.

If the person looking at the advertisement seems to have a history of online activities browsing that segment of products, this engine is smart enough to send out personalized offers for those segments and will try to make a sale and upsell the product.

Upon making a sale, the central engine is very responsive to cross-selling, trying to sell items that complement or supplement existing purchases. These are triggered mostly through online channels.

All the above components team up together to form an integrated AI-based Retail Marketing Intelligence System. The next section showcases all the interconnections among its components.

4. Architecture

The architecture is quite flexible. Any new component can be added in the future and the architecture could also support multiple shelves being monitored because each of those entities can be plugged into the central engine.

- The ad board has a camera mounted on it, backed by a dedicated system. This system processes the live feed and decides what data needs to be stored for further processing using a consent filter.
- The product shelf has a camera that actively monitors the shelf and has a dedicated object detection system. It is connected to the central engine via a central server that populates the data in the user's cart shown in the form of a dashboard.
- The checkout kiosk is an NLP-based solution that houses a camera, a microphone and a speaker unit. The voice-based engine is backed up by the Rasa NLP server and eventually the desired action is passed to the central server.
- The central engine is connected to all the other units and uses socket connection to communicate. The central engine itself leverages an AWS S3 Bucket and uses AWS Rekognition for data storage and face recognition. The engine stores all the details in a local NoSQL database named the Retailing Database. The central engine has a Recommendation and Offer Engine that analyzes the lead behavior, does lead scoring and sends out offers. It is this component that tracks online activities and facilitates promotional offers. These offers can be sent out via email or mobile message based on the type and scenario.

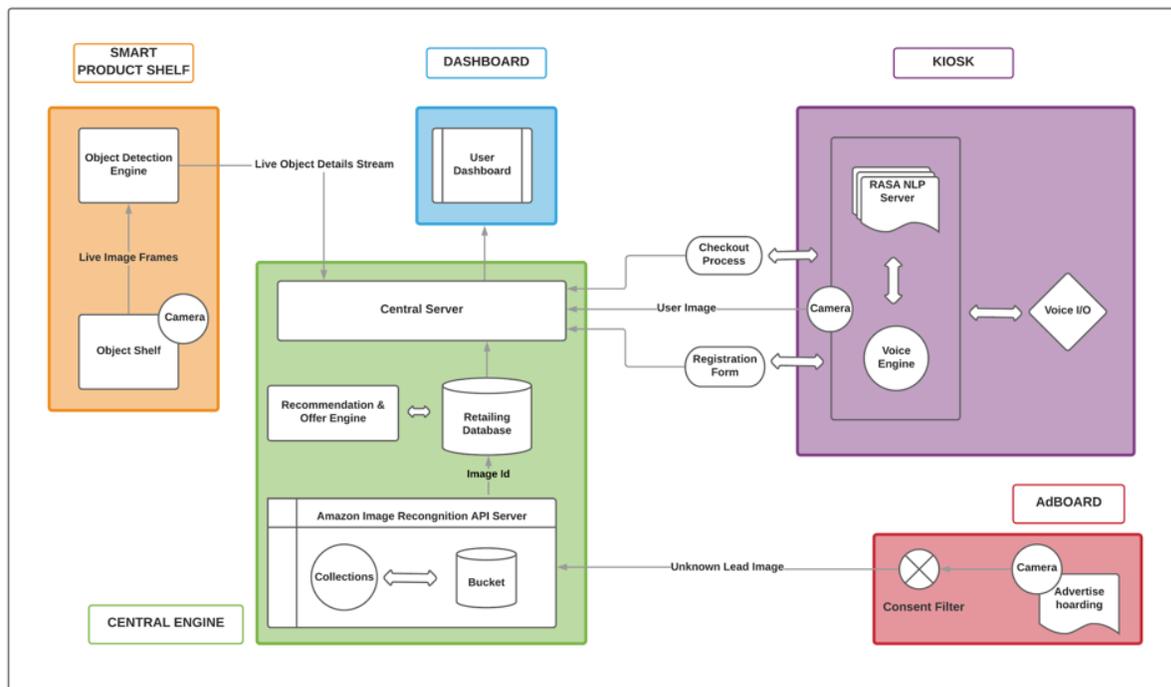


Fig 2: Architecture Diagram

5. Sequence Diagram

The figure below shows the typical series of interactions that would happen between the customer and the various entities that are a part of this system, from the first interaction to trying to make an upsell and even cross-sell. The sequence diagram also shows how the customer interacts in the fully automated store.

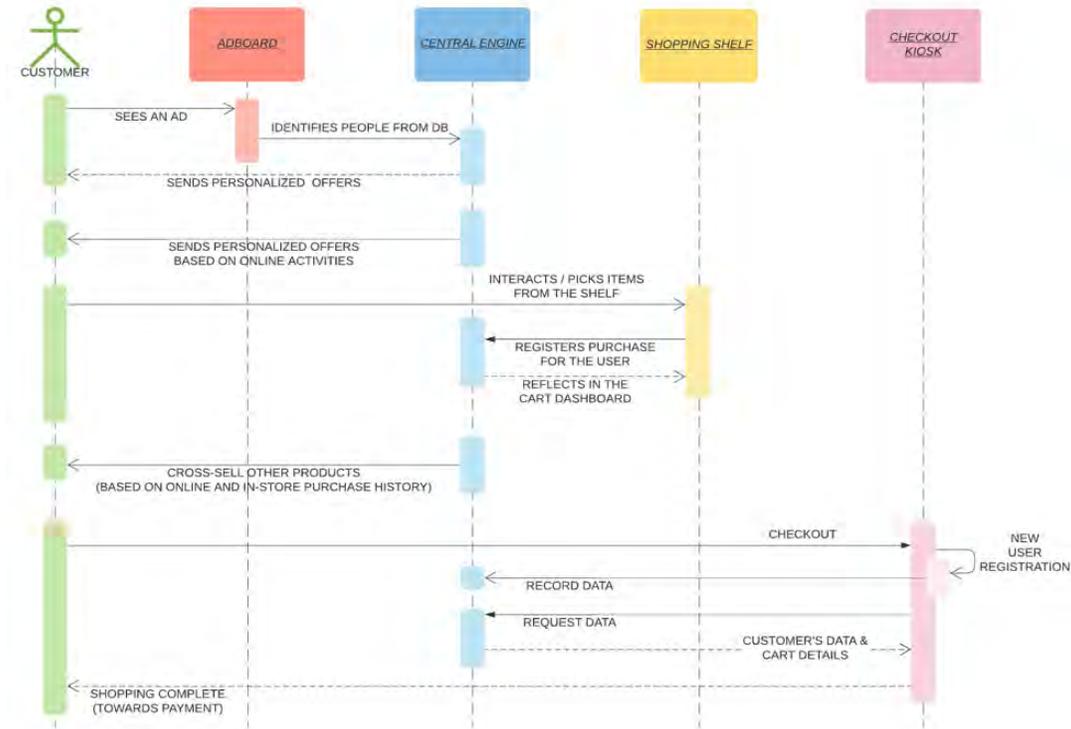


Fig 3: Sequence Diagram

Once a customer is identified as showing interest in an advertisement, the central engine registers the interests in its database where it carries out promotional activities for that lead. Based on customers' online activities, the central engine rolls out promotional activities according to a well-defined algorithm.

When a customer interacts with the shopping shelf, a lot of activities happen under the hood. Once an item is picked up from the shelf, the central engine updates the database, registers the item, and updates the dashboard in real time. If a product is put back when a customer changes their mind, the central engine removes the item from the cart and simultaneously updates the user dashboard.

For any customer who comes to check out, the central engine matches the facial data sent out by the kiosk and segregates the registered and unregistered customers.

For unregistered users, it facilitates a registration mechanism and stores the information in the database (name, mobile number, email, details about items purchased, etc.). For registered customers, it identifies the person, fetches the data from the database, provides the kiosk with the required data and moves towards payment.

6. GDPR-Compliant System

To make this marketing solution General Data Protection Regulation (GDPR) compliant, a number of aspects have been taken into consideration while designing such a system.

Filter Minors' Data: No facial data related to minors is stored in our databases. The first level of filtering is done through the registration form where children's facial data bypasses the face recognition system. The second level happens on the database side where AWS Rekognition's age prediction system filters out underage kids before storing any data in the database.

Database Encryption: All the databases that contain personally identifiable information (PII) are considered sensitive and follow database access control. All PII information is encrypted before saving.

Consent: In order to comply with the strict consent policy, the following items were introduced:

- A positive opt-in with no pre-ticked boxes. The user may freely agree or disagree to having their information collected.
- The information can be withdrawn by the user anytime.
- Specific, granular details about what personal information is being collected and why, presented differently from the terms and conditions page.
- Information about how long the data will be stored.
- A record of a user's consent(s), updated as any changes are made to technologies or features the consent relates to.

Data Purging: The data is automatically purged at regular intervals to help protect privacy.

7. Applications

This technology may have the following applications and more, depending on the nature of the business and its needs.

- Offline stores can offer at-store recommendations based on buying pattern data and online consumer activities.
- Marketing strategists can understand customer behaviors and provide customized products and offers to the desired audience.
- Inferences taken from data generated in the retailing system can boost location-based marketing strategies and improve supply chain management and demand planning.
- Facilitates market forecasting and cost optimization, which improves positioning over competitors.
- Predictive merchandising enables businesses to more accurately forecast inventory needs, which helps reduce overstocking and associated costs.
- Real time in-store visual monitoring and surveillance.

8. Future Developments

In the future, we aim to have a more robust and dynamic system that incorporates more features and addresses the current shortcomings. A few priorities for the near future include the below.

User activity tracking capabilities wherein each user activity is recorded by a highly advanced Human Body Pose estimation designed specially for brick-and-mortar stores using Deep Learning. This feature aims to create a more personalized shopping experience as well as increase overall store sales.

More advanced algorithms for object detection to deliver more precision. This aims to provide a seamless experience for the customer.

Ability to identify the shopper interacting with the product shelf. Currently, this solution works only for a single person interacting with the shelf and cannot distinguish between two people fiddling with the products. In future updates, we aim to work on this much anticipated functionality.

9. Conclusion

The proposed retail marketing system showcases the future of retail and online amalgamation. This system is intelligent enough to understand consumer buying patterns based on their online and in-store activities. This next-gen blend of retail and online shopping backed by the power of Artificial Intelligence helps in product recommendations, upselling and cross-selling, cost optimization, market forecasting, in-store visual surveillance, and more.

Our solution can automate each part of the shopping process in brick-and-mortar stores and could provide a seamless shopping experience for the consumer. In today's burgeoning digital world with tons and tons of data, one should buckle up for the impact of automation and AI technologies across all core functions and proactively address its implications for the workforce. The longer one waits to catch up with the advancements, the higher the risk of falling behind permanently.

About the Authors

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Vashu is an AI enthusiast and passionate about building software products. He is a firm believer in exploring the granular details of even minute elements, which is evident in his research and innovation. His R&D work includes Algorithm Design, Mathematical Modelling & Simulation and Artificial Intelligence.

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