AI-Powered Voice Assistant System for Smart Supermarket Shopping

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***Abstract*— In the digitally enhanced world, the internet has created with immediate solutions to various daily activities. The consumers look for efficient and quick ways of solutions to daily chores and repeated activities. Supermarkets are turned into new pace of operations with smart and automated shopping procedures enable the consumers to experience seamless shopping experience. The advancements in Artificial intelligence (AI) and Machine learning (ML) technology provides solutions to numerous challenges, offers solutions to get activated through programmatic instructions, analysis and predictions. The system reduces the complexities in making manual process. AI chat bot provides interactive solutions, maintains customer relationships, provides solutions to customer needs integrated within the purchase portal. The proposed system is focused on creating a voice assistant to make seamless shopping in super markets more accessible and easier. Convolutional neural network (CNN) is implemented to make feature extraction process, with Natural language processing (NLP) for analysing the user queries. The goal of the proposed system is to provide smart retailing solutions and convenient shopping experience through voice assisted systems. The performance of the system is tested with various levels of real-time test cases and validations.**

***Keywords*— *Smart shopping, Artificial intelligence, Machine learning, Consumer products, Edge computing*.**

I. INTRODUCTION

Voice assistant enabled shopping chat bot plays an important role in making shopping malls into smart shopping models. The global era of technology rapidly changes the lifestyle of people, making online shopping more common, but still the traditional shopping methods are widely followed. In the traditional shopping method, buyers need to spend lots of time making purchases and also face time consumption during manual billing. With the help of Artificial Intelligence (AI) and Machine Learning (ML) technology, the needs of the customer can be optimized, and the sensor-based smart product inventory system can check out the product cost and implement automatic billing systems. The system is also offered with an indoor navigation system using smart sensors and optimized decision-making through machine learning [1]. Smart microcontroller named ESP32 CAM based product identification system and seamless shopping experience is provided with the hardware-based smart shopping cart implemented in real time. The existing approach also integrates the payment gateway to make contactless transactions and provide a seamless experience to the customers. The system is enabled with an efficient algorithm for increasing the commercial value of the product, which in turn enhances the scalability of the system [2]. An automatic smart shopping basket using IoT application is implemented using the embedded microcontroller and smart sensors. The smart basket is implemented using Arduino, which is used for data transmission to receive the product value and make the automated billing process to provide customers with a seamless shopping experience. The system faces challenges in terms of handling the hardware components in the shopping cart when dynamically changing products are involved [3]. Various hardware-based implementations are considered to handle the smart shopping experience for consumers. The primary challenges present in the hardware-based approaches struggle during the dynamic updating of products. The automated billing system also needs regular updates of the products and optimization of time consumption for handling shopping inputs. The primary challenge present in the system is the dynamic changes in the products [4]. Smart machine learning algorithms are implemented to optimize decision-making towards a smart shopping experience. The primary challenges in machine learning algorithms deal with the requirement of multiple datasets to train the model. To handle real-time datasets, a combination of software-implemented optimized frameworks with respect to hardware-based systems is required [5].

- The proposed system considers the voice assistant enabled smart shopping system through natural language processing (NLP) for user query analysis. The Convolutional neural network (CNN) is implemented for feature extraction process.

- The AI enabled voice assisted system provides seamless shopping experience to the consumers providing best products suggestions, best offers, reliable solutions to consumer queries on specific products through deep knowledge-driven approach with deeper insights.

The rest of the paper is organized by discussing the literature survey in the Section II, followed by system challenges in the existing implementations, the drawbacks are explored in Section III, the design methodologies are explored in Section IV, the obtained results and discussions are added up in the Section V.

II. BACKGROUND STUDY

Wang et al. (2025) E-commerce business has come up with significant growth, facilitating advanced shopping experience. The influence of internet of things (IoT) in retails industry reduces the time consumption for billing, increases the efficiency in shopping experience. A neuro-fuzzy based approach with Fog computing in cloud environment is developed here. The author explored the benefit of IoT implementation in smart shopping protocol. The system is tested with numerous test cases, offering the access to the proposed platform and evaluates the benefit of IoT in smart shopping system which reduces the energy wastage, increases the quality of customer experience [6].

Zulfiqar et al. (2025) The author enhanced the quality of shopping through leveraging the reinforced learning (RL) model for navigation in the shopping mall, Long short-term memory(LSTM) model network for forecasting the flexible point of scale, comprises real time capturing of data to provide automated shopping and billing system. Conventional method of shopping-cart lacks in dynamic tracking capability. To bring inventory management, customer relationship management (CRM), personalized shopping experience, to bridge the gap between the customer demands and business solutions the proposed method is developed [7].

D. Johnson et al. (2022) A production scheduling process is explored in the presented system. An multi-agent reinforced learning is implemented to explore the dynamic assembly jobs and handling the challenges in the production scheduling process. The author implemented double DQN (Dynamic queuing network) algorithm for job scheduling process. Through centralized server and training protocol, the assembly process is monitored. Rule-based heuristic technique is implemented to control the monitoring robot. The system is developed with crucial keys, further enhance quality of decision making in complex process involved production environment [8].

S. Lan et al. (2026) Customized and personalized assembly monitoring and scheduling technique is implemented in the presented system. The system considers the workload, work schedules, action space as preprogrammed inputs to optimize and provide the effective decision making. The flexible program commands offer knowledge-driven guidance for rapid convergence of data. The experiment shows the scalable solutions to real time environment on production monitoring. The proposed system with reinforced learning model achieved remarkable result in customized production monitoring [9].

M. S. Javaid et al. (2025)The author explored the sustainable product evaluation management (PEM) to store, secure and retrieve the data through blockchain technology. The presented system considers smart deploying through online shopping. AI-driven smart inventory management protocol is implemented. Using raspberry Pi 5 with web cam interface with real time data collection is made achieving 99.2%. Machine learning models are helpful to optimize the real-time data. The presented system considers random forest regression model and linear regression model to get involved in the data analysis and optimizing the input data. The presented system performance is evaluated through R Squared value of 0.68 for linear regression, and 0.89 for Random forest regression [10].

Various existing implementations are considered for analysis thereby considering the challenges, failed models and opted solutions are highly helpful to create a novel approach for the proposed work [11] – [20].

III. SYSTEM DESIGN

The major challenge persist with the conventional method of shopping assistants suffers during the dynamic inputs. The system often faces challenges due to specific product names identification, price comparisons, managing the given shopping list and lack of automated update with new products and discounts. The voice assisted super market support system through AI chat bot offers reliable solution with automated bill generation through NLP model. The long waiting manual billing process, manual pricing makes time consumption in large super markets. The voice assisted system focused on providing seamless shopping experience to the consumers on product selection through voice assistants, automated billing through optimized NLP, feature extraction through Convolutional neural network (CNN) etc. The challenges lead to time-consuming and frustrated shopping experience to consumers. To enhance the quality of satisfaction for the customers, to meet their needs towards product selection, applying discounts and necessary guidance the proposed method is focused. The primary challenges discussed in the existing state of art approaches such as longer waiting time with traditional methods, faces challenges in dynamic product variations are considered here to create an innovative novel approach using voice assisted models.

IV. METHODOLOGY

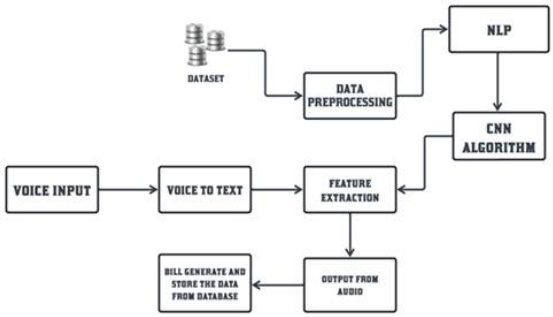

Fig 1. System architecture for Smart Shopping assistant

Fig 1. Shows the smart shopping assistant architecture using Conventional neural network (CNN) with natural language processor (NLP) with voice assistant module. The input voice collected from consumers are feature extracted to understand the query, through voice to text conversion. The extracted features are further analyzed with the database trained with global text bags.

Chatbot module

The module is used to make voice assistant enabled super market experience through customized chat bot. The chat bot is power through AI module. The core component involved in the proposed approach is the AI powered chat bot. It understands the user query effectively, analyses and provides relevant answers through NLP module. The chat bot can be developed in two ways. The static chat bot which can able to answer the fixed questions. On the other hand, the AI powered chat bot offers adoptive answers by deep-knowledge driven approach using suggested computational thinking. The proposed system is developed with customized chat bot which deals with the customer language, the input query effectively through natural language processing thereby providing concurrent answers to the queries regarding the product pricing, discounts, seeking help for specific products etc. To check the availability of the product, customers need to approach the sales person in the super market in case of traditional method. Where in proposed method, AI module provides complete support for answering the user queries.

NLP Module

The proposed NLP module in the voice assistant powered super market system act as a cutting-edge feature for understanding the user inputs effectively and process the text to make more relevant answers. The proposed NLP module allows to handle the chat bot queries, interpret and respond accurately to engage the customers with meaningful replies. By leveraging the proposed algorithm, the NLP and CNN work together. The comprehensive patterns assessed by the AI module chooses the relevant answers from the database. The NLP module can understand multiple accents and speech. The NLP module acts as the crucial part of the proposed voice assisted super market system. The chat bot with smart AI assisted module provides deep understanding of the user queries, as well as to create useful insights on the questions raised by the customers. The conversation patterns are helpful to make deep forecast on the specific customer needs and further helpful to provide future product recommendations based on the pattern of queries and answers.

CNN Algorithm

The convolutional neural network (CNN) is utilized for feature extraction process to read the user queries; visual information shared in the chat bot. The deep learning architecture effectively analyses the pattern of inputs, objects shared within the chat bot. By integrating the CNN model, our proposed chat bot significantly improves the quality of user experience by offering interactive visual chats, towards finding the price of the products, discounts available, to access extra offers and suggested products etc. The capability of the proposed vice assisted model offers intelligent tool capable of understanding the user given natural language inputs, verbal and visual inputs too. In certain products, by scanning the bar codes the product information is clearly explained to the user.

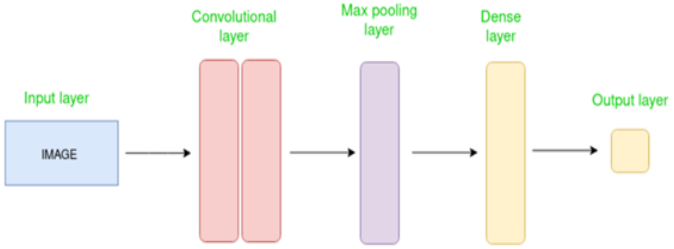

Fig 2. CNN architecture

Fig 2. Shows the CNN architecture of the proposed AI powered smart shopping module. The CNN architecture consists of input layer, convolutional layer, Max pooling layer, Dense layer and output layer. The levels of convolution depend on the complexity of the input data.

Database

The proposed system is integrated with database in the voice assistant powered super market model where AI chat bot is the crucial component. The database creation is the primary role in the proposed system that needs tremendous efforts to add up all the product related information, relevant discounts need to be given so that the AI module can access all the grounds of the database for choosing the best and accurate answer. The proposed database ensures the real-time access of the dynamic inputs up to date information to handle the user query accurately and formulates relevant responses. By effectively organizing and recalling the input data, the system personalizes the user input and creates a deep knowledge driven insights towards the specific user. The proposed approach considers all the relevant promotions and deals to serve the customer with best pricing and satisfied outcome. The fundamental goal of the proposed system is to provide the consumers the seamless shopping experience, as well as best shopping pattern to make then a repeated customer which increases the scope of the business.

V. RESULTS AND DISCUSSIONS

Fig 3. Front-end interactive module

Fig 3. Shows the interactive front-end module to get access into the AI power smart shopping system. The chat bot is integrated within the proposed web application thereby initiating the user interaction to get input queries on products, pricings, doubts on specific products etc. The back-end module with AI power analysis optimizes the inputs and provide suggested offers, products based on their interests. The customized framework continuously logs the user information to create a deep-knowledge driven patterns helpful to forecast future products.

Fig 4. E-Commerce shopping platform

Fig 4. Shows the E-Commerce shopping platform developed in the proposed system, where AI assisted Chat bot is implemented. The products are listed with images, price, weight and brand. The user needs to select the products based on their needs thereby optimizing the products suggestions satisfying the user. The complete system is automated with customer relationship maintenance is done in the backend.

Fig 5. Automated Bill generation

Fig 5. Shows the automated bill generation module provided with the AI powered super market system. Based on the products selected by the user, the quantity, pricings are updated. Unique QR code is added in the bill to generate payment initiatives by the consumer. The details added in the bill are customized to provide efficient outcome.

The primary challenges in traditional method of purchasing is the long queue process for billing. To overcome the frustration of long waiting for billing, an automated billing protocol is developed. The unique QR (quick response) code is developed to get the payment. Once the purchase has done by the customer, based on the products selected the automated bill is generated with customer name.

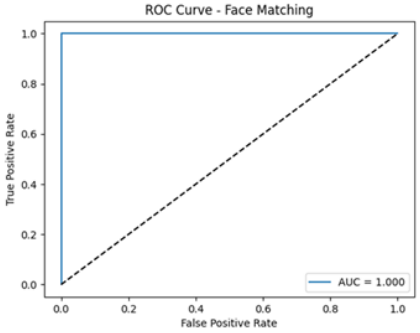

Fig 6. Face matching module

Fig 6. Depicts the Face matching module results showing the false positive rate with respect to true positive rate etc. As per the trained database, the face matching process is enabled. The accuracy under curve is 1.00 for the proposed model.

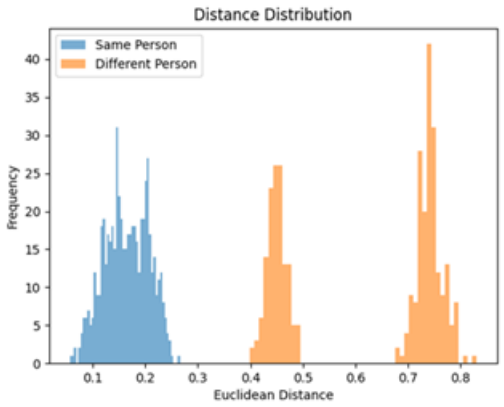

Fig 7. Euclidean distance vs Frequency

Fig 7. Shows the Euclidean distance (ED) of the face input opted to the module comparing the frequency of occurrences. The module is helpful to optimize the inputs and understand the pattern of same person and repeated person to analyse the access score. The system analyses the business growth based on the repeated consumer inputs.

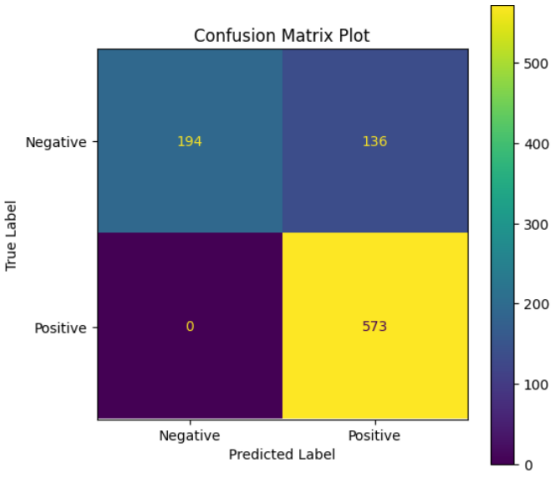

Fig 8. Confusion matrix of proposed face recognition process

Fig 8. Shows the confusion matrix obtained through the face recognition process optimized for AI voice assisted smart shopping system. The confusion matrix shows the number of analysis process positive predictions, negative predictions when comparing the database information. Through the complete iterations, the analysis is plotted here.

Table 1. Performance measure of proposed smart shopping module

Performance Metric	Different Person	Same person
Accuracy	0.85	0.85
Precision	1.00	0.81
Recall	0.59	1.00
F1Score	0.74	0.89

Table 1. shows the performance measure of proposed AI powered smart shopping system in which 85% accuracy is achieved, 100% precision on different person, 81% on same person identification is done. 59% Recall value on different person and 100% on same person is obtained. The F1score of 74% on different person, 89% on same person is achieved.

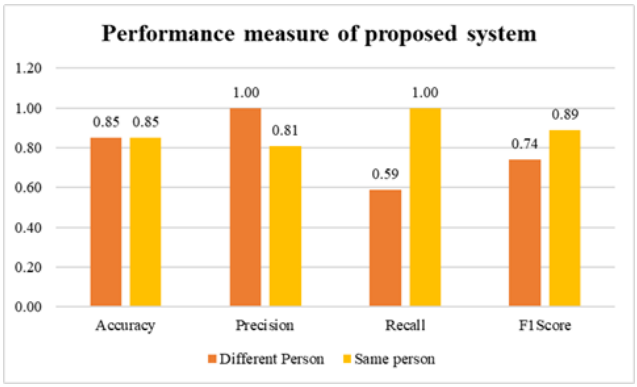

Fig 9. Performance measure of proposed approach

Fig 9. Shows the performance measure of proposed AI powered Smart Shopping system with voice assisted guidance for seamless shopping experience. The presented system achieved 85% accuracy towards different person identification and same person identification. An average precision of 88%, average recall score of 85% and F1score of 84% is achieved. Undergoing various levels of iterative testing the proposed model achieved an efficient outcome on face recognition.

VI. CONCLUSION

AI power voice assisted systems are demandable research work in current digital era. The need for seamless shopping experience is crucial for all consumers. The development of Artificial intelligence (AI) technology offers solutions to various challenges in the retail industry. To offer an efficient response to consumers during shopping, a voice assisted reliable chat5 bot is developed. The purpose of the system is to provide flexible responses to the users to experience seamless shopping pattern in terms of selecting the product, availing the best offer, organizing the discounts even more. The complete automated framework implemented here offers quick billing system through QR code enabled automated bill. The process of accessing the smart products, flexible discounts make the consumers to move from one time customer to repeated customer. The primary goal of the proposed approach is to offer all services in one roof by adding advanced features to the web site, including the AI powered chat bot, face recognition, AI analyzer for suggestion of best products and offers to consumers. The presented system acts as one of the efficient models for smart shopping plan. Further the presented system is enhanced by adding up more advanced real-time datasets, working on optimized computational thinking scope of the model, increasing accuracy and reducing the processing time etc.

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