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Enhanced Shopping Experience: Deep Learning and Rfid for Visually Impaired Shoppers

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ABSTRACT: The proposed project aims to develop an innovative Smart Shopping Trolley system tailored specifically to meet the needs of visually impaired individuals, thus enhancing their independence and accessibility during shopping experiences. This system represents a convergence of advanced technologies, including RFID (Radio Frequency Identification), deep learning with the YOLO (You Only Look Once) algorithm, voice assistance modules, ultrasonic sensors, and IoT (Internet of Things) connectivity. The integration of these technologies enables real-time object detection and identification, allowing visually impaired users to navigate through retail environments safely and independently. As users move through the store, the YOLO algorithm processes images captured by a camera mounted on the trolley, recognizing various objects such as groceries, household items, and personal care products. The system then provides auditory feedback on detected items, empowering users to make informed decisions while selecting products. Additionally, RFID readers integrated into the trolley automatically register items as they are placed inside, updating the shopping list and inventory information in real-time. To ensure user safety, the system includes ultrasonic sensors capable of detecting obstacles in the trolley's path and triggering alerts to prevent collisions. Integration with IoT technology enables seamless tracking of selected items and updates to inventory management systems, enhancing efficiency for both users and store operators. Overall, the proposed Smart Shopping Trolley system offers a comprehensive solution to enhance accessibility, efficiency, and independence in retail environments for visually impaired individuals.

KEYWORDS: RFID, Deep learning, IOT, YOLO algorithm

I. INTRODUCTION

In the rapidly evolving landscape of retail technology, the Intelligent Shopping Trolley for Visually Impaired People stands out as a beacon of innovation, heralding a new era of accessibility, efficiency, and empowerment for shoppers of all abilities. Building upon a foundation of cutting-edge technologies, including RFID, deep learning with the YOLO algorithm, voice assistance, ultrasonic sensors, and IoT connectivity, this revolutionary system represents a significant leap forward in enhancing the shopping experience for visually impaired individuals while catering to the needs of all users. At its core, the Intelligent Shopping Trolley embodies a seamless integration of advanced functionalities, each carefully calibrated to enhance user interaction and streamline the shopping journey. The optimization of object detection capabilities, powered by the YOLO algorithm, ensures unparalleled accuracy and speed in identifying a diverse range of products in real-time. Through precise auditory feedback, users receive instant recognition of detected items, reducing their reliance on external assistance and fostering a newfound sense of autonomy and independence.
Moreover, the integration of RFID technology marks a pivotal advancement in automatic item identification and inventory management. As users navigate through the store, RFID tags seamlessly register each product placed in the trolley, facilitating swift and accurate checkout processes. Real-time updates to inventory management and billing systems not only streamline operations for store operators but also enhance efficiency and convenience for shoppers, revolutionizing the retail experience.

But the innovation doesn't stop there. The incorporation of ultrasonic sensors adds an extra layer of safety and reassurance, detecting potential obstacles in the trolley's path and providing timely alerts to mitigate hazards. Buzzer alerts for product selection confirmation further enhance user confidence, ensuring a smoother and more seamless shopping experience for all.

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As we invite shoppers to embrace the future of retail with our Intelligent Shopping Trolley, we envision a world where accessibility, efficiency, and innovation converge to redefine the shopping landscape. Whether you're visually impaired or seeking a more streamlined and convenient shopping journey, our trolley promises to revolutionize your experience like never before.

II. LITERATURE REVIEW

Literature research is the most important step in the software development process. Before creating a tool, it is important to determine the time factor, profitability, and company strengths. With these in place, the next 10 steps are to decide which operating systems and languages you can use to develop your tools. Once programmers start building tools, they need a lot of external support. This support can come from experienced programmers, books, or websites. The above evaluations will be considered in the development of the proposed system before building the system.

SYED RIAZ UN NABI JAFRI, SHAHZAD AZAM HASHMI, AMNA SHABBIR, AGHA HASSNAIN MOHSAN, MYRIAM HADJOUNI, AND SAMIH M. MOSTAFA, "Parametric Classification of Furniture From Point Cloud Developed Using Low Cost Trolley Based Laser Scanning System", 2023

This paper presents a parametric classification methodology to identify common indoor and outdoor furniture objects present in the 3D Cartesian point cloud of the surveyed environment. For this purpose, a low cost custom made trolley based scanning and surveying system has developed using orthogonal integration of two popular Hokuyo-30LX 2D laser scanners. The developed system has been successfully used to generate 3D point cloud of the environment using Simultaneous Localization and Mapping (SLAM) technique. The instrumentation system of the trolley has been interfaced through Robot Operating System (ROS) for online processing and recording of all sensorial data. While classification of the furniture present in point cloud has been done in offline mode using Random Sampling and Consensus (RANSAC) based parametric segmentation technique. The innovative furniture detection has applied on each scan in order to reduce the region of interest in the developed point cloud. In addition, the validation of the classified furniture objects has been performed using Fuzzy Logic. Multiple indoor and outdoor vicinities have been scanned and modelling results have been found accurate nearer to ground truth. In comparison to available surveying solutions present in the local market, the developed system has been found faster and precise to produce more enhanced structural results with minute details.

MOBEEN SHAHROZ, MUHAMMAD FAHEEM MUSHTAQ, MAQSOOD AHMAD, SALEEM ULLAH, ARIF MEHMOOD, AND GYU SANG CHOI, "IoT-Based Smart Shopping Cart Using Radio Frequency Identification", 2020

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. After this, each product information shows in the Mobile application. The customer easily manages the shopping list in Mobile application according to preferences. Then shopping information sends to the server wirelessly and automatically generates billing. This experimental prototype is designed to eliminate time-consuming shopping process and quality of services issues. The proposed system can easily be implemented and tested at a commercial scale under the real scenario in the future. That is why the proposed model is more competitive as compared to others.

RUCHI GUPTE, SHAMBHAVI REGE, SARAH HAWA, DR. Y S RAO ,DR. RAJENDRA SAWANT, "Automated Shopping Cart Using RFID with a Collaborative Clustering Driven Recommendation System", 2020

Recent advancements in technology have seen a significant reduction in human intervention. New technologies are introduced to replace outdated conventions where emphasis is put on the incorporation of Artificial Intelligence and Automation in our daily lives. With the current COVID-19 pandemic, reducing human interaction in everyday actions has now been deemed necessary. One of the most important sectors affected, the shopping industry, needs to adapt to meet government and social security standards. This paper addresses a Smart Shopping Cart System where the entire shopping experience is automated and handled by the customer. It details a more efficient online mode of shopping which not only reduces the need for hands-on staff but also provides specialized recommendations to users using collaborative clustering to update the shopping experience and meet the demands of our time. The current shopping

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system has many limitations, and introduction of Radio-frequency identification (RFID) technology as the core identification mechanism can prove useful for applications such as security, safety and inventory management.

PEI WANG, BIN GUO, ZHU WANG, ZHIWEN YU, "SHOPSENSE: Customer Localization in Multi-person Scenario with Passive RFID Tags", 2019

Indoor localization serves as the basis of sensing and understanding human behaviors and further providing personalized services in many scenarios, such as retail stores, warehouses and libraries. However, existing indoor localization technologies cannot fulfill the requirement of such scenarios due to incapable of identifying different persons, severe object occlusion when there are multiple persons, or privacy concerns. On the basis of wide deployment of RFID tags in such scenarios, in this paper we develop a RFID-based localization system, i.e., ShopSense, which is not only able to accurately localize multiple people simultaneously but also differentiate them even when there are a lot of obstacles in the environment. Extensive experiments demonstrate that ShopSense can locate the shopping cart at a median tracking error of 20 cm and can locate the customer's location with a median tracking error of 25 cm.

III. METHODOLOGY

The methodology for developing the Intelligent Shopping Trolley for Visually Impaired People encompasses a structured approach that integrates multiple technological components to achieve seamless functionality and user satisfaction. The project begins with an in-depth analysis of user needs and requirements through extensive research and user interviews. This foundational understanding guides the selection and integration of advanced technologies, including RFID, deep learning with the YOLO algorithm, voice assistance modules, ultrasonic sensors, and IoT connectivity. The development process involves several key stages, starting with the design and implementation of the hardware components, such as RFID readers, cameras, and ultrasonic sensors, followed by the integration of software systems for object detection, voice assistance, and IoT communication. Throughout the development lifecycle, iterative testing and refinement are conducted in collaboration with visually impaired individuals to ensure usability, accessibility, and accuracy of the system. Additionally, scalability and compatibility considerations are addressed to facilitate seamless deployment in diverse retail environments. The methodology prioritizes user-centric design principles and agile development practices to deliver a comprehensive solution that enhances independence, accessibility, and efficiency for visually impaired shoppers.

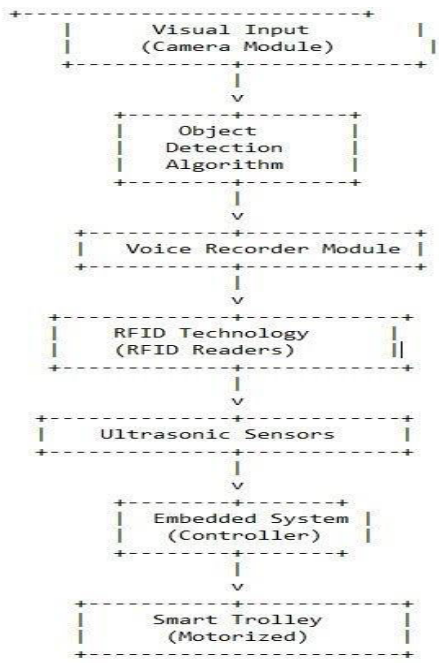

Fig1. The architecture of the proposed system

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IV. RESULTS AND DISCUSSION

The implementation of the Intelligent Shopping Trolley for Visually Impaired People represents a significant advancement in enhancing accessibility, efficiency, and independence in retail environments. Through the integration of RFID technology, deep learning with the YOLO algorithm, voice assistance modules, ultrasonic sensors, and IoT connectivity, the system successfully addresses the diverse needs of visually impaired individuals while catering to the broader spectrum of shoppers.

The results of our project demonstrate the seamless functionality of the Smart Shopping Trolley, providing real-time object detection and identification capabilities to visually impaired users. The YOLO algorithm, operating on images captured by the trolley-mounted camera, accurately recognizes various products within the store environment, including groceries, household items, and personal care products. Users receive precise auditory feedback on detected items, enabling them to make informed decisions during the shopping process. This functionality significantly reduces the reliance on external assistance, fostering greater autonomy and independence for visually impaired shoppers.

Furthermore, the integration of RFID technology enhances the efficiency of item identification and inventory management. RFID tags embedded in products automatically register with RFID readers integrated into the trolley as items are placed inside, facilitating swift and accurate checkout processes. Real-time updates to inventory management systems ensure accurate tracking of selected items and optimize stock replenishment strategies for store operators. This streamlined approach not only improves operational efficiency but also enhances the overall shopping experience for users, minimizing wait times at checkout counters.

The inclusion of ultrasonic sensors adds an additional layer of safety and convenience to the system, detecting obstacles in the trolley's path and triggering alerts to prevent collisions. Buzzer alerts for product selection confirmation further enhance user confidence, ensuring a smoother and more seamless shopping experience for all users, regardless of visual impairment.

In conclusion, the results of our project demonstrate the effectiveness and versatility of the Intelligent Shopping Trolley in enhancing accessibility, efficiency, and independence in retail environments. By leveraging advanced technologies and innovative design principles, our system redefines the shopping experience for visually impaired individuals, empowering them to navigate through stores safely and independently. Moving forward, further refinements and enhancements to the system will continue to drive innovation and inclusivity in retail technology, paving the way for a more accessible and equitable shopping experience for all.

ALGORITHM EXPLANATION:

The core algorithm powering the Intelligent Shopping Trolley for Visually Impaired People is the YOLO (You Only Look Once) algorithm, a state-of-the-art deep learning model designed for real-time object detection in images. YOLO operates by dividing the input image into a grid of cells and predicting bounding boxes and class probabilities for objects within each cell simultaneously. This unique approach enables YOLO to achieve high detection accuracy while maintaining real-time performance, making it well-suited for applications such as our smart shopping trolley.

How does it work?

The YOLO algorithm begins by processing the input image through a convolutional neural network (CNN), which extracts features at multiple spatial scales. These features are then used to predict bounding boxes and class probabilities for objects of interest within the image. Each bounding box represents a detected object, while the class probabilities indicate the likelihood of each detected object belonging to a particular class (e.g., groceries, household items, personal care products).

During inference, the YOLO algorithm efficiently scans the input image and generates predictions for bounding boxes and class probabilities in a single pass through the CNN. This streamlined approach enables real-time object detection, allowing the smart shopping trolley to quickly recognize and identify various products as the user navigates through the store.In the context of our project, the YOLO algorithm operates on images captured by a camera mounted on the shopping trolley. As the user moves through the store, the algorithm continuously analyzes the captured images, detecting and identifying objects such as groceries, household items, and personal care products in real-time. The system then provides auditory feedback to the user, conveying information about the detected items and empowering them to make informed decisions during the shopping process.

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Overall, the YOLO algorithm serves as the backbone of the Intelligent Shopping Trolley, enabling seamless and efficient object detection in retail environments. Its robust performance and real-time capabilities play a crucial role in enhancing accessibility, efficiency, and independence for visually impaired individuals, revolutionizing the shopping experience for users of all abilities.

OUTPUT:

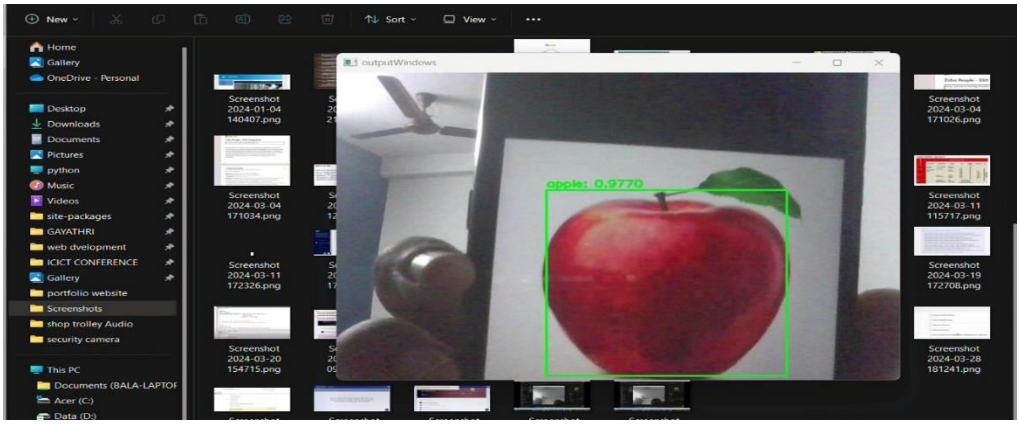

Fig2.Object detection

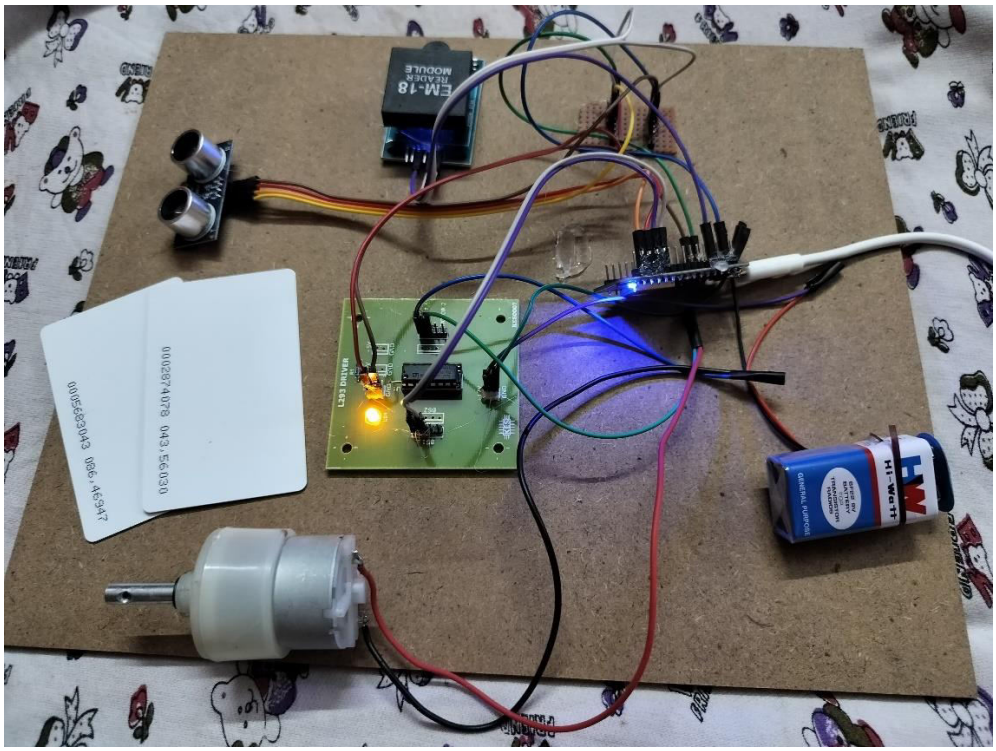

Fig3. Hardware sample output

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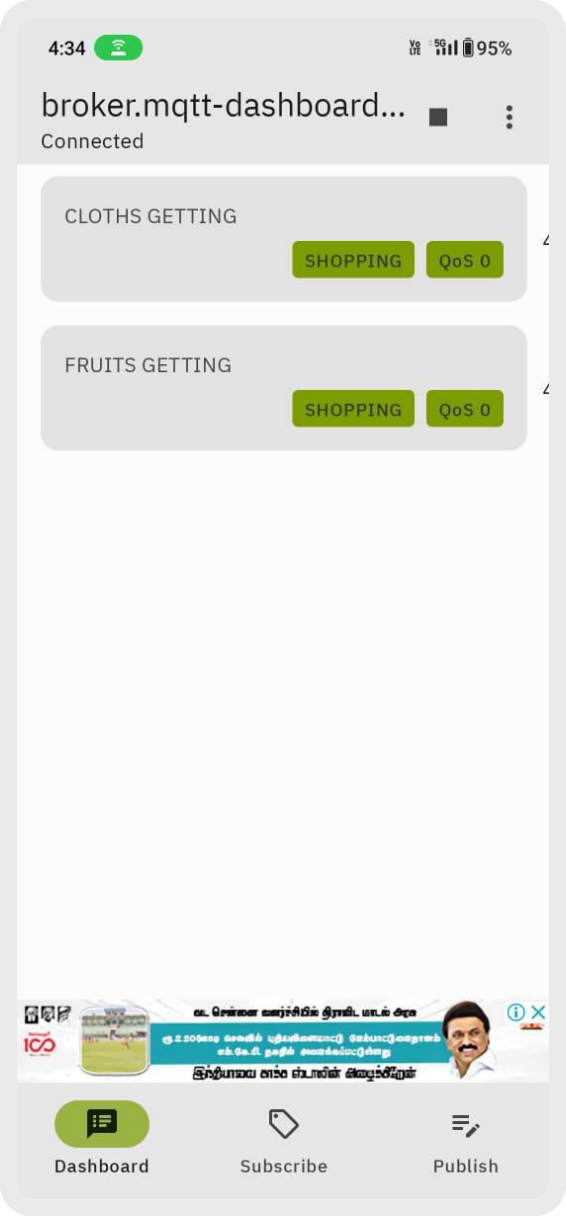

Fig4. Mobile App sample output

V. CONCLUSION

In conclusion, the Smart Shopping Trolley system represents a significant advancement in enhancing the shopping experience for visually impaired individuals. By integrating cutting-edge technologies such as the YOLO algorithm, RFID, voice assistance, and ultrasonic sensors, the system offers a comprehensive solution that addresses the challenges faced by visually impaired shoppers. Through enhanced independence, efficient navigation, informed decision-making, improved safety, real-time inventory updates, and accessibility features, the proposed system aims to promote inclusivity and autonomy in retail environments. With its seamless integration of various technologies and focus on user empowerment, the Smart Shopping Trolley system heralds a new era of accessibility and convenience for visually impaired individuals, revolutionizing the way they engage with the shopping experience.

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REFERENCES

[1] D. Ma, J. Hu, and W. Wang, ‘‘Differential game of product–service supply chain considering consumers’ reference effect and supply chain mem- bers’ reciprocity altruism in the online-to-offline mode,’’ Ann. Oper. Res., vol. 304, nos. 1–2, pp. 263–297, Sep. 2021.
[2] H.-C. Chi, M. A. Sarwar, Y.-A. Daraghmi, K.-W. Lin, T.-U. Ik, and Y.-L. Li, ‘‘Smart self-checkout carts based on deep learning for shopping activity recognition,’’ in Proc. 21st Asia–Pacific Netw. Oper. Manage. Symp. (APNOMS), Sep. 2020, pp. 185–190.
[3] W. Shucui, Y. Jinjun, and W. Hongli, ‘‘Research on the reconstruction of consumers, goods and scenes in new retail based on new technology,’’ IET Smart Cities, vol. 2, no. 3, pp. 122–125, Sep. 2020.
[4] Y. Fan, J. Kou, and J. Liu, ‘‘Research on the influencing factors of customer loyalty in offline supermarket under new retail model,’’ in Proc. 4th Int. Conf. Manage. Eng., Softw. Eng. Service Sci., Jan. 2020, pp. 216–220.
[5] S. Yi, ‘‘Reform of sports health supermarket based on AR technology,’’ Frontiers Sport Res., vol. 2, Jan. 2020, Art. no. 020511.
[6] A.-V. Anttiroiko, P. Valkama, and S. J. Bailey, ‘‘Smart cities in the new service economy: Building platforms for smart services,’’ AI Soc., vol. 29, no. 3, pp. 323–334, Aug. 2014.

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