

Image Processing And Weight Sensing Based Billing System

Abdul Hadi K K

M241266EC

M.Tech Telecommunication

INTRODUCTION

- The traditional retail billing process requires manual barcode scanning or item input, which is time-consuming and prone to human errors.
- Automation in retail is becoming essential due to increased customer expectations for faster, error-free checkout processes.
- This project introduces a system that uses **image processing** to automatically recognize items and **weight sensors** to verify the accuracy, enabling a seamless billing experience.



“Imagine a retail checkout where items are placed on a counter, recognized instantly by a camera, and their weights are verified simultaneously. No need for barcode scanning or manual inputs.”



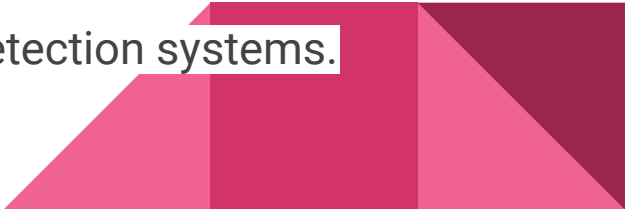
LITERATURE REVIEW

Object Recognition in Modern Systems

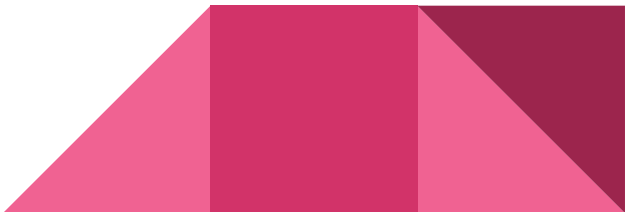
- Object recognition is integral to modern systems.
- Applications: Optical Character Recognition (OCR), inspection systems, chip defect identification.
- Existing models perform well in specific tasks but lack versatility.
- Need for bold advancements in computer vision models.



Computer Vision and Image Detection

- Image detection is crucial in computer vision.
 - Fields include image recognition, object detection, and image generation.
 - Popular algorithms:
R-CNN (Region-based Convolutional Neural Network),
Fast-RCNN,
Faster-RCNN,
RetinaNet (Retina Neural Network) ,
SSD (Single Shot MultiBox Detector),
YOLO.
 - High accuracy and real-time performance in image detection systems.
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Deep Learning and Object Detection

- Deep Learning bridges the gap between human and computer intelligence.
 - Convolutional Neural Networks (CNNs) yield accurate results in object detection.
 - Example: ImageNet Large-Scale Visual Recognition Challenge (ILSVRC-2012 challenge).
 - CNNs help in recognizing and assigning confidence scores to detected objects.
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Issues in Existing Billing Systems

- Shops rely on manual billing systems.
- Problems: time-consuming, error-prone, and manual object counting.
- Current grocery detection systems use QR codes or barcodes.



PROBLEM MOTIVATION

Challenges with current billing methods:

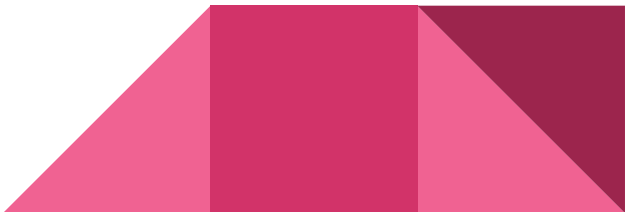
- Manual barcode scanning is slow.
- Prone to theft and checkout fraud.
- Increasing demand for a faster, contactless billing system.



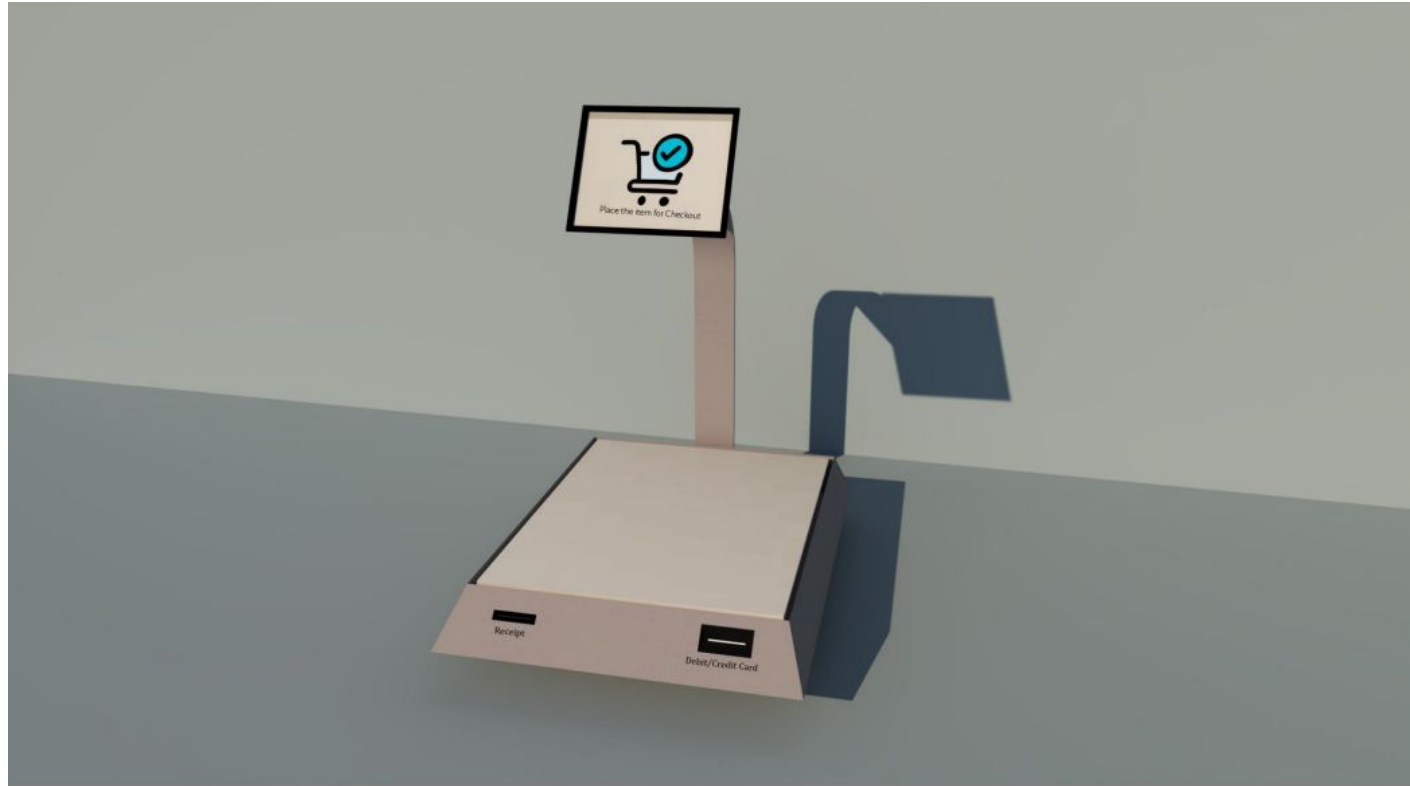
“In a typical retail store, long checkout lines cause customer dissatisfaction. A system that automates this process with minimal human intervention can significantly enhance the customer experience.”



OBJECTIVE

- Develop an efficient billing system for retail stores.
 - Use image processing to identify products based on their visual features.
 - Integrate weight sensors to verify that the product identified visually matches its expected weight.
 - Provide an accurate, fast, and seamless billing process without requiring human interaction.
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PROPOSED DESIGN

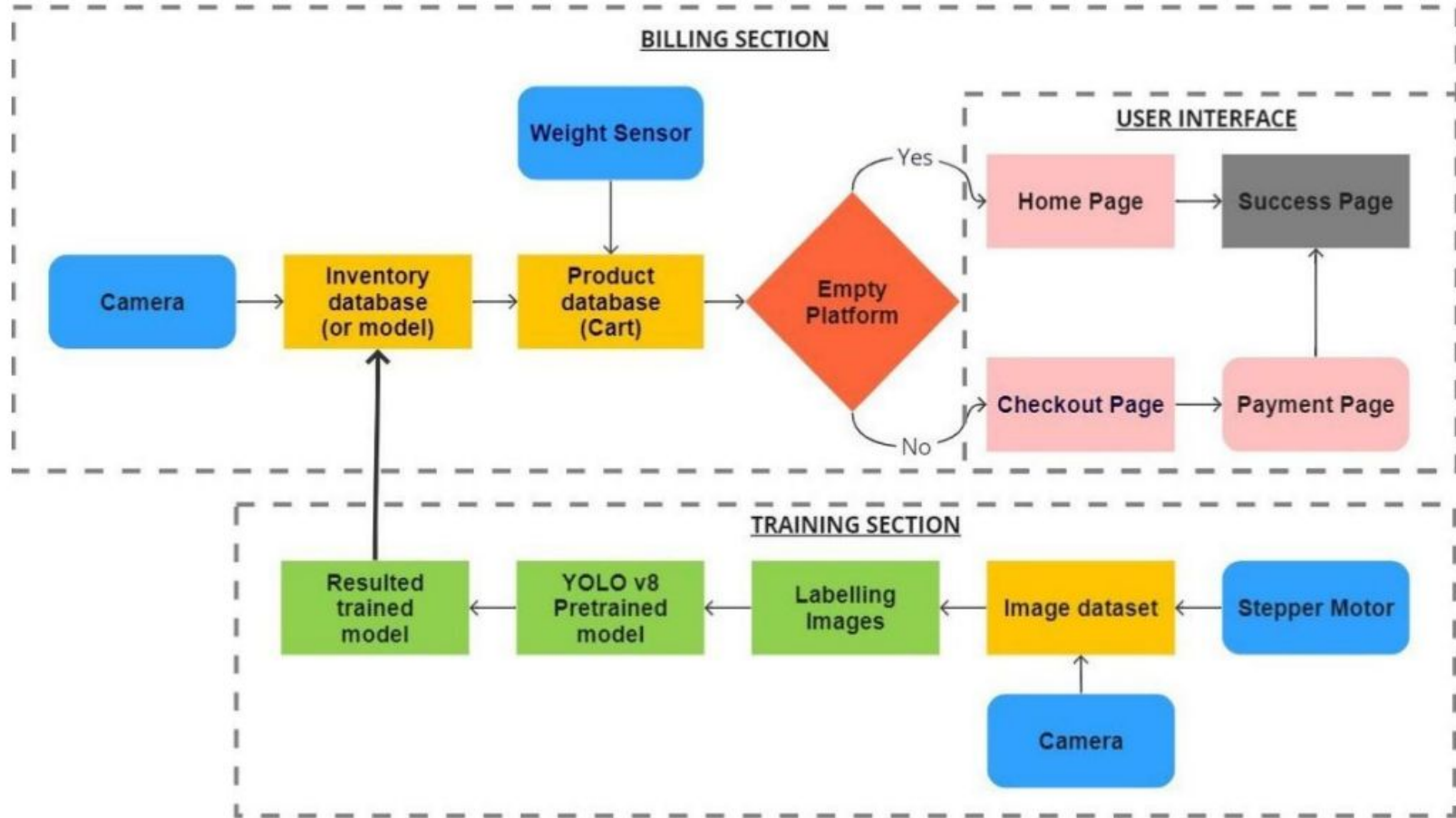


METHODOLOGY

- **Image Processing:** Use machine learning algorithms to train the system on identifying various retail items.
- **Weight Sensing:** A load cell is used to measure the weight of items.
- **Workflow:** Item placed → Image captured → Weight measured → Cross-checking product with database → Billing.
- **Algorithms used:** OpenCV for object recognition, machine learning for enhancing detection accuracy, and Python to integrate image and weight data.



WORK FLOW



“Once a product is placed on the counter, the camera captures its image, which is then processed using OpenCV. Simultaneously, the weight sensor checks if the item’s weight matches its product description in the database. If both match, the product is added to the bill.”




SOFTWARE AND HARDWARE USED

Software:

- OpenCV for image processing.
- Python as the programming language.
- PyTorch for machine learning models.
- ReactJS for client-side UI development

Hardware:

- Camera for capturing images of items.
 - Weight sensors to verify the mass of each product.
 - Microcontroller (Arduino) to weigh the product.
 - Monitor for displaying the billing information to customers.
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COMPONENTS USED (Hardwares)

CAMERA MODULE



LOAD CELL



ARDUINO BOARD



STEPPER MOTOR



HX711 ADC



PC WITH GPU



COMPONENTS USED (Software)

PyTorch



Python



React



OpenCV




Flask

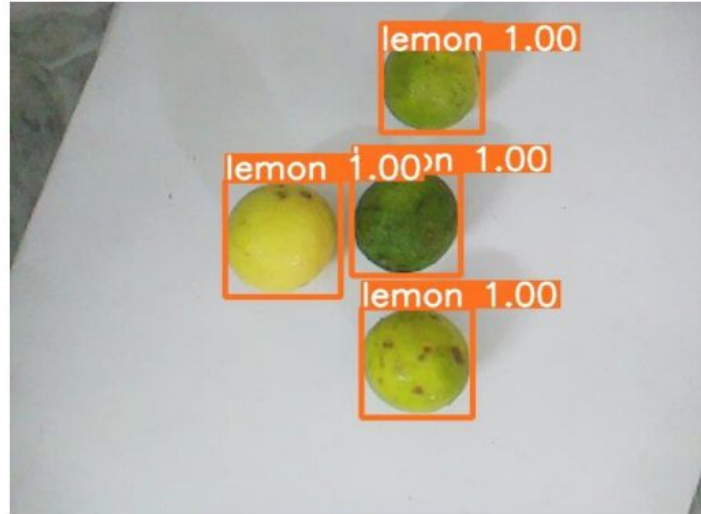


PostgreSQL

CONCLUSION

- This system provides an automated and accurate billing solution for retail stores, reducing checkout time and improving customer satisfaction.
 - By integrating image processing with weight sensing, the system ensures error-free billing and enhances security against theft.
 - Future enhancements could include integration with mobile payment systems and further accuracy improvements in object recognition.
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RESULT



REFERENCE

- M. Sugadev, K. Sucharitha, I. R. Sheeba and B. Velan, "Computer vision based automated billing system for fruit stores," *2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)*, Tirunelveli, India, 2020, pp. 1337-1342, doi: 10.1109/ICSSIT48917.2020.9214101
- M. Grover, B. Verma, N. Sharma and I. Kaushik, "Traffic control using V-2-V Based Method using Reinforcement Learning," *2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS)*, Greater Noida, India, 2019, pp. 507-512, doi: 10.1109/ICCCIS48478.2019.8974540.
- Sil, R., Roy, A., Bhushan, B., & Mazumdar, A. (2019). Artificial Intelligence and Machine Learning based Legal Application: The State-of-the-Art and Future Research Trends. 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS). doi: 10.1109/icccis48478.2019.8974479

- Wu BF, Tseng WJ, Chen YS, Yao SJ, Chang PJ. An intelligent selfcheckout system for smart retail. In System Science and Engineering (ICSSE), 2016 International Conference on 2016 Jul 7(pp. 1-4). IEEE
- Grinberg, Miguel. Flask web development: developing web applications with python. " O'Reilly Media, Inc.", 2018.
- Abadi, Martín, et al. "Tensorflow: Large-scale machine learning on heterogeneous distributed systems." arXiv preprint arXiv:1603.04467 (2016).
- Vogel, Patrick, et al. "A low-effort analytics platform for visualizing evolving Flask-based Python web services." 2017 IEEE Working Conference on Software Visualization (VISSOFT). IEEE, 2017.

