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Artificial Intelligence based Automatic Billing System

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Abstract: *This is age of artificial intelligence which gives an approach where we can make processes easy by utilising various modern tools and algorithms. The process applied in the modern shopping marts are semi-automatics, and it is observed that the process is somewhere dependent on the manual efforts. It is helpful to produce purchasing bills efficiently with required modification on run time, but we cannot say this is an automated billing system. To obtain the complete automated billing system there is need to utilise the capability of artificial intelligence technologies. The modern computer vision, machine learning along with deep learning and intelligent database supports gives significant scenario to develop systems for automatic billings. The present research study tries to give an overview to develop Artificial Intelligence based automatic billing system with no human interaction.*

Keywords: *Artificial Intelligence, Billing System, Computer vision, machine learning, human effort.*

1. INTRODUCTION:

It is well known that the processes used in modern shopping marts are semi-automated and still rely to some extent on manual intervention. While they enable efficient generation of purchase bills and allow for real-time modifications, they cannot be classified as fully automated billing systems. To manage work with such kind of billing system the Barcodes are extensively utilized in supermarkets, where checkout counters typically employ laser barcode scanners. This is the process utilised the manual inferences and efforts. These scanners require the item to be positioned close to the sensor, often demanding manual effort from the cashier. As each product must be scanned individually, the process becomes labour-intensive and time-consuming, especially in high-traffic stores handling thousands of items daily. On the other side radio frequency identification (RFID) technology is also presents a faster and more efficient solution, its high implementation cost currently limits its adoption in most grocery retail environments.

The modern advancements in computer vision, machine learning, deep learning, and intelligent database support to provide a strong foundation for developing fully automated billing systems. This research study aims to present a framework for creating an AI-based billing system that operates without the need for human intervention. The study presents a fully automated billing system that combines AI with a automatic moving platform and high-resolution camera to identify products and generate bills without human interaction. By utilising a custom dataset, the system will identify the moving items in any directions as well as orientation, offering a fast and reliable alternative to traditional billing methods.

2. RELATED WORK:

There are lots of work are done on the same concept with variety of approaches. The accomplishment of the task is need of the time, and it will be implemented through various modern tools associated with computer vision, image processing, deep learning and artificial intelligence. Here we are discussing some of the works which are already done for the same task.

Anas Usmani et al. (2024) The author proposed study has been developed to meet the growing demand for an efficient billing solution in the retail sector. By integrating artificial intelligence (AI) and computer vision, the system aims to significantly enhance the billing process, boosting efficiency, accuracy, and customer satisfaction. Through the use of deep learning architectures for object detection and image processing automatic product identification can be done and generate bills will generate in real-time.

Manisha Agrawal and Nathi Ram Chauhan (2017) proposes a Hybrid PCA-SIFT-FREAK algorithm for 3D object recognition within automated billing systems. This approach offers a balanced trade-off between accuracy and

memory efficiency, significantly outperforming traditional methods. Comparative studies demonstrate improved performance, with potential for real-time application, achieving high recognition rates while minimizing computation time and memory usage [2].

Zhao et al. (2019) they provide a comprehensive review of the evolution of object detection, from traditional methods to advanced deep learning frameworks. It highlights the limitations of earlier approaches and underscores the advantages of deep learning in extracting high-level features. The review discusses a range of deep learning architectures, their modifications, specialized detection tasks, and includes experimental analyses and suggestions for future research [1].

Suraj Charade et al. (2020) introduced a smart unstaffed retail system leveraging Python-based image processing to improve the shopping experience. By training an end-to-end classification model on stock-keeping unit (SKU) images, the system achieves accurate SKU recognition and counting, effectively overcoming the challenges of traditional unmanned retail solutions [4].

Rajkumar Patil et al. (2021) they proposed Automatic billing, driven by AI-based object detection in this paper, enables contactless shopping and reduces manpower needs, offering a faster, cost-effective alternative to traditional methods with up to 90% accuracy. Increasing training data and time improves model performance, aided by GPU acceleration. Future work will focus on boosting speed, accuracy, and simplifying custom dataset creation.

Meet Arvind Bhanushali et al. (2025) they introduced about the billing system which efficiently manages financial transactions, handling subscriptions, one-time purchases, and recurring payments. It features secure payment processing, automated invoicing, user-friendly account management, and robust security measures. Built-in analytics help optimize revenue and support business growth.

3. OBJECTIVES:

The objective of the study is to eliminate human interaction from the billing system by utilising modern technology in the fully automatic mode. The technology will be applicable for the entire supermarket, malls and marts.

4. METHODOLOGY:

Many object detection algorithms exist but they often struggle with issues like limited accuracy and slow processing speeds which hamper their practical application. This deficiency can be removed by using of YOLO (You Only Look Once) algorithm which addresses these challenges by combining high speed with strong accuracy. This algorithm adopts a unified approach to object detection by employing a single convolutional neural network (CNN) that processes the entire image in one forward pass. It divides the image into a grid, with each cell predicting a set number of bounding boxes, along with confidence scores and class probabilities.

A custom dataset is used for object detection, consisting of multiple images of the product along with corresponding product information.

The development of a custom dataset begins with the collection of a large and diverse set of images. After image collection, the next step is annotation, where each object is labelled by annotation tool. The annotated dataset is import into YOLO model and train the model. In this method we are using of python programming language. In which two libraries TensorFlow and Keras are used for building and training the model. Object detection model is developed by using of these libraries for image processing.

5. ALGORITHM :

1. *Start*
2. *Load the YOLO model and product labels*
3. *Initialize camera or video input*
4. *Capture an image/frame*
5. *Detect objects in the frame using the YOLO algorithm*
6. *Identify each detected product and count quantities*
7. *Match each product with its price from the database*
8. *Calculate total cost based on detected items and quantities*
9. *Display the bill with item names, quantities, prices, and total*
10. *Save or Print the bill (optional)*
11. *Repeat steps 4–10 until billing is complete*
12. *Stop*

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6. FLOCHART:

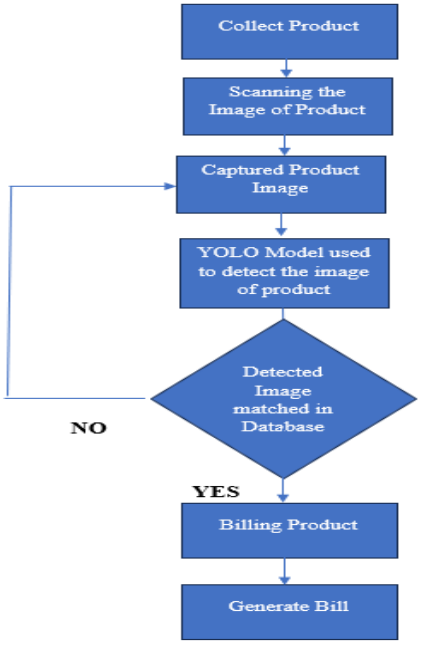

Figure-1: Flowchart/ Block Diagram of project

7. YOLO ARCHITECTURE :

YOLO (You Only Look Once) is a real-time object detection algorithm that treats object detection as a single regression problem, rather than using separate stages like region proposal and classification. The YOLO architecture consists of a single convolutional neural network (CNN) that takes the entire input image, divides it into an $S \times S$ grid, and predicts bounding boxes and class probabilities directly for each grid cell. Each grid cell is responsible for detecting objects whose centre falls within it. The network outputs a fixed number of bounding boxes, each with coordinates (x, y, width, height), a confidence score indicating whether the box contains an object, and probabilities for each object class.

In later versions, YOLO introduced anchor boxes to handle objects of varying aspect ratios and sizes, as well as more advanced backbones like Darknet-53 (YOLOv3) and more efficient designs in YOLOv5 and YOLOv8. After the model predicts multiple boxes, a technique called Non-Max Suppression (NMS) is used to remove overlapping or duplicate detections and keep only the most confident ones.

The key advantage of YOLO is its speed and efficiency—it processes images in a single forward pass, making it ideal for real-time applications like autonomous vehicles, video surveillance, and AI-based automatic billing systems. YOLO provides a balance of accuracy and performance, making it one of the most widely used object detection algorithms in practical AI system

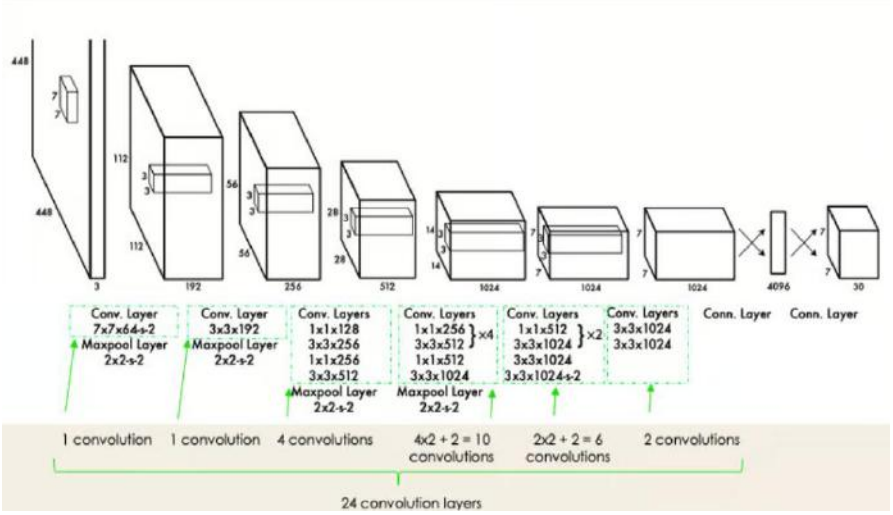

Figure-2: YOLO Architecture

Ref: https://www.datacamp.com/blog/yolo-object-detection-explained

8. COMPREHENSIVE OUTCOME:

An AI-based automatic billing system using YOLO (You Only Look Once) leverages real-time object detection to identify products and generate bills without manual scanning. The system uses a camera to capture images or video of items placed at a checkout area. The YOLO architecture, a fast and efficient convolutional neural network, processes the entire image in one pass by dividing it into a grid and predicting bounding boxes, class labels, and confidence scores for each grid cell. Each detected item is matched with a predefined product database to retrieve prices. The algorithm then counts quantities, calculates the total cost, and generates a bill automatically. YOLO's speed and accuracy make it ideal for billing applications where multiple products need to be detected instantly, improving efficiency and reducing human error in retail or cafeteria environments.

9. CONCLUSION:

The Artificial Intelligence-based Automatic Billing System using the YOLO algorithm offers a fast, efficient, and accurate solution for automating the checkout process in retail and food service environments. By leveraging real-time object detection, the system can identify multiple products simultaneously without the need for barcodes or manual input. This not only speeds up the billing process but also reduces human errors and enhances the overall customer experience. The integration of YOLO makes the system practical for real-world deployment due to its balance of speed and accuracy, demonstrating the powerful potential of AI in transforming traditional billing systems.

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