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Smart Billing Cart using Deep Learning for Mall Administration

Apurva Sutar[1], K. J. Karande[2], A. D. Harale[3]
[1]P.G. Scholar, [2]Professor, [3]Asst. Professor,
[1,2,3]Department of Electronics and Telecommunication Engineering, SKN Sinhgad College of Engineering, Pandharpur (MS), India.
Corrospondance author- apurvasutar05@gmail.com

Abstract - Customers went to the mall to purchase and spend money on the goods they required. Before generating a customer's bill, it is preferable to confirm how many items have been sold out. One must make an effort to select the right item while going to the store to make a purchase. After that, waiting in queue to get invoiced is stressful. Therefore, we propose that without RFID-based smart cart solution be developed to record both online invoicing transactions and purchased goods. The technology will also provide product recommendations based on user purchasing patterns from a centralised source. In this system, each cart has camera is attached to it, and each item in the shop will have identified using YOLOv4. The transaction and recommendation systems for the web will be centralised. The recommended system comprises of a camera that weighs the attached object and a load cell that utilises deep learning to determine the item. The system will generate the bill when the consumer scans an item with the help of the cart's fixed camera. Numerous methods may be used to accomplish object recognition Bounding boxes are produced by techniques like R-CNN using area proposals, and these boxes are utilised to operate classifiers continuously. After that, the duplicates are eliminated using a post-processing technique. R-CNN is a slow method of object recognition. We do this by using the YOLO concept.
Keywords- Billing cart, Camera, Arduino Nano, Deep learning (DL), YOLO

1. Introduction

One of the challenges in the modern purchasing system is having to follow the payment line through this laborious process [1–7]. The project's goal is to reduce the typical length of time a consumer spends at a mall by introducing an automated payment system that uses RFID technology [8–13]. Since the introduction of wireless technology, electronic commerce has advanced to the point that it may now be utilised to improve the comfort, convenience, and effectiveness of daily living [14–22]. This article's major goal is to provide a centralised and autonomous billing system [23-30] leveraging connection provided by ZigBee [24] and camera [23]. Previously there will be RFID tags on every item sold at big shops and retail hubs that identify its category. There is a PID (Product ID Device) on every machine. An Arduino Nano [31], an LCD [32], an RFID reader [33], an EEPROM [34], and a ZigBee module [35] are specific PID components. A central database will also be available, from which we may recommend items to clients [36–40]. Recent developments in chip fabrication technology are increasing the viability of innovative applications [41, 42]. The fast expansion of the RFID

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business is having an influence on several industries [43]. Customers will be helped with their purchases by the product suggestions and data displayed on the LCD screen of the shopping cart [44–49]. On an LCD, characters [50], numbers [51], and pictures [52] may all be seen. [53].

Our banknotes were first printed, but we later shifted to electronic production. The barcode scanner was used to read and scan the numbers [55]. But afterwards, we focused upon the RFID tag-based smart tram billing system, which uses a digital storage device for information copying and detection [56, 57].

The price of an item is obtained by imaging it, which is then stored in a system's memory once the buyer completes their transaction. When shopping at a mall, a person utilises a trolley, and when they are through, they must proceed to a counter to make their purchases. Barcode billing is a time-consuming, labor-intensive process. It takes a lot of effort as we must physically analyse each label. The inability to read barcodes at large distances is another disadvantage. Our objective is to create an automated invoicing system that makes use of camera [58].

The present system was put into place utilising the traditional barcode reading method. The barcode scanner is required for each product, which makes this method exceedingly challenging to scan (Fig. 1). A barcode reader is a part of an electronic equipment that scans barcodes. Customers have to stand in long queues to be invoiced since this operation lacks an automated billing mechanism. The barcode billing method is hence inefficient. This ultimately leads to lengthy queues. To prevent it altogether, we used a variety of technological tools, like an RFID-based invoicing system. However, the process for billing reasons takes the longest. There is currently a lengthy wait to pay the bill as a result[59,60,61].

Figure 1: Barcode scanner.

The camera-based smart cart technology is recommended as a remedy for the time-consuming procedure. While the customer continues to remain the item in the smart trolley, the camera and algorithm quickly recognises the object by scanning the label. Additionally, it receives an instantaneously created electronic product code number. Information about item pricing and total billing is stored in Arduino Nano memory via an LCD[62,63,64]. This digital product number provides information about the product, such as the title and price. The issues in malls are depicted in Fig.

Figure 2: Problems in shopping malls.

2. Literature Survey

This study [1] proposes an intelligent cart to facilitate simple purchases. For simple viewing, this copy is fastened to the tram. An RFID reader that's a component of the system is used to scan each object that has an RFID tag on it. The cash is processed in the smart trolley. On the LCD panel, the item's name and price were shown. RFID and Arduino are used in this [2] article. Along with pricing information, the item's weight and quantity are provided. If the database doesn't match that, a buzzer will sound. Another example is a smart cart with RFID, IR, and ultrasonic sensors that operates on Arduino [3]. The relevant amount is delivered to the billing department when the item's tag is detected by the reader. Once the matter has been resolved, you may pick up the physical copy from the desk.

Intelligent Cart with Auto-Accounting: The author of this [4] article creates a method that enables an easy-to-use accounting trolley. They function as an illustration of the system with the added features that generate and update the client's bill. The amount and item will be shown on the LCD panel. They can settle the remainder right away by heading to the billing desk.

There are more small and larger retail malls that previously since customer interest and expenditure are increasing [5]. The traditional billing method has to be regularly enhanced to raise the level of shopping. With the use of an RFID reader, that shopping cart creates the purchase bill right on the cart, enhancing the present approach. Both the wait time of the customers and the burden of the mall employees will be reduced.

At a desk, a smart cart that employs automatic billing, product data, and product suggestions utilising RFID transfers the invoice which is displayed on the screen to system memory. This is made feasible by the RFID module's capacity to wirelessly swap the bill. One of the problems with this system architecture is that we have to input a key after all the products and prices are shown. Probably won't be any further product additions or cancellations after that [6].

There may be a sizable rush at [7] malls on holiday weekends, especially when there are promotions and special offers. When buying needs today, customers prefer shopping online over shopping in malls and use websites like Amazon, among others [8]. In order to better handle the difficulties of combining online and physical purchasing, this article suggested virtual cart for a remedy [9].

3. Methodology

The YOLOv4 method was used to locate the object [7]. By extracting numerous vectors from the picture and applying bounding boxes, it may be established if anything will be found inside the grid. Because it is built up from the Pascal VOC dataset, wherein the overall size of items is enormous, it is inappropriate to utilise YOLOv4 to just recognise things of little scale. The YOLOv4 framework [7] is adept at locating minute objects. The image is divided into S-X-S network by the framework. Boundary boxes and a trust level are predicted by network cells. Our degree of confidence indicates how convinced we're that the thing A belongs to box B. YOLOv4 is used to find items. For object identification, as seen in Fig. 3, we employ YOLOv4. YOLOv4 splits the image across numerous grids and forecasts the perimeter of the intriguing object in each grid. Tensorflow and Keras libraries were originally placed into our system to aid with object detection, and YOLO via the darknet[66].

The darknet is constructed using Tensorflow library expressions. YOLO-based object identification is made possible by the installation of several software applications. In order to get exact findings, datasets are recorded at a greater resolution. The systems utilised to recognise items were trained using the datasets that were acquired. Datasets, that were originally JPG files, are transformed to XML files for teaching the system.

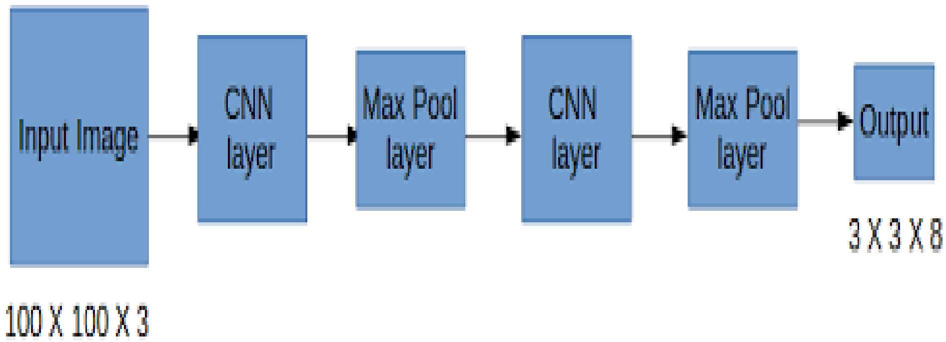

Figure 3: YOLO framework.

The XML files which were recently modified are called annotation files. These files provide captions for the photographs as well as the locations for the boundaries of the images. With the aid of the programme, the image is transformed. We need the device to detect carrots, therefore for instance, software is used to gather up and compress the database of bringel photos [67]. We create the boundary encircling the desired object, give it the name "Bringel," and finally save it. There will be an XML file created after publication. The coordinates and label that we supplied are visible when we look at that XML file. The cfg and dimensions files are used to run the software after the XML files for each dataset have been prepared. Layers of neural network (NN) are contained in the setup file, and parameters files are employed to modify weights following training on the provided datasets. Checkpoint records are created once training is complete, and they contain the updated weights. Before the object detection algorithm is deployed in testing, the checkpoint data are analysed. The completion of training is indicated by the production of checkpoint files.

The suggested system employing camera, a Arduino Nano, and a display is shown in Fig. 4.

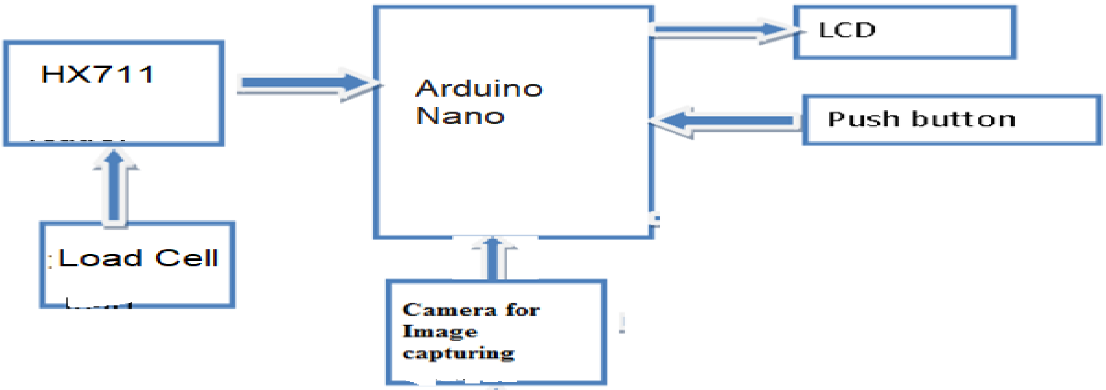

Figure 4: Proposed system.

Fig. 5 shows the Flow chart for our proposed system below.

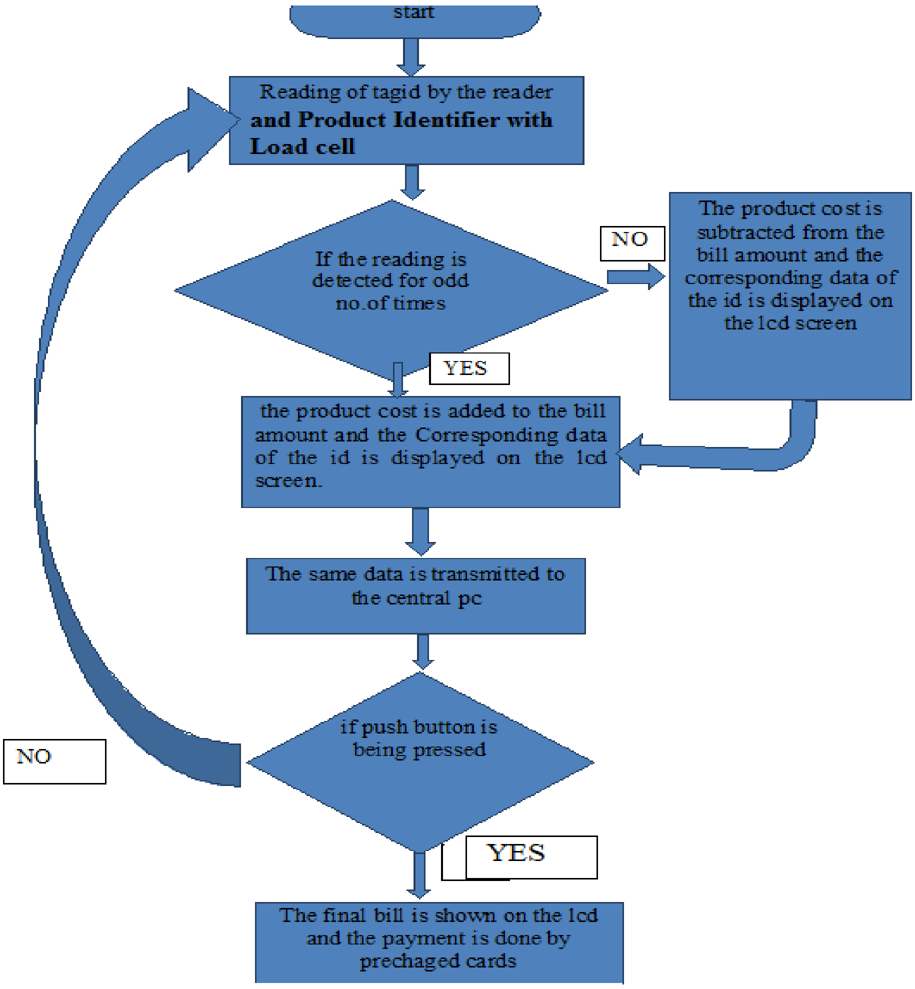

Figure 5: Flow chart for the proposed method.

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4. Result and Discussions

Fig. 6 below depicts the suggested tram. With the use of YOLOv4, the product identity, amount, and identifier are all included in this trolley. The client's desired item may be recognised in this situation, and our programme will automatically weigh and charge the consumer for it. A copy of the bill is submitted to the system for approval, and it is displayed on an LCD monitor.

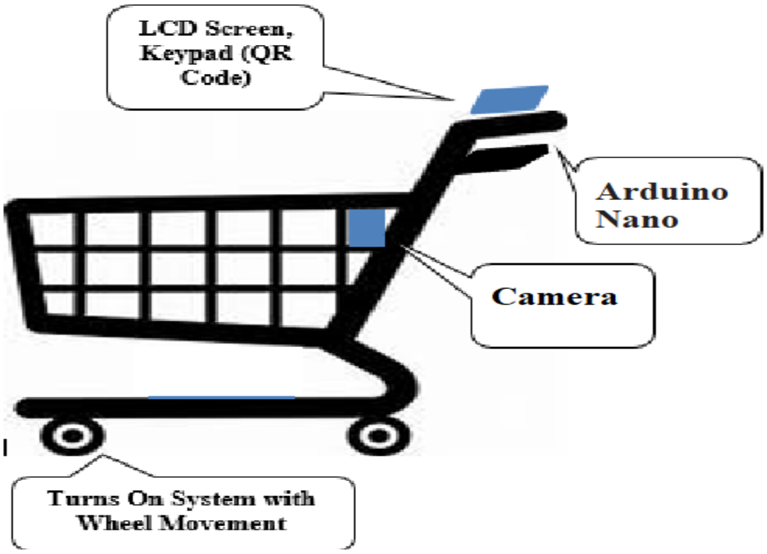

Figure 6: Proposed trolley using Camera, Arduino Nano

Figure 7 shows the identification of items in cart using our system. Here we measures the weight of the item. This is the first step in our system. After identification next step is billing as per the amount set as a price for the items. The billing of Items is shown in figure 8 below. Once the bill is generated, the customer complete the billing process.

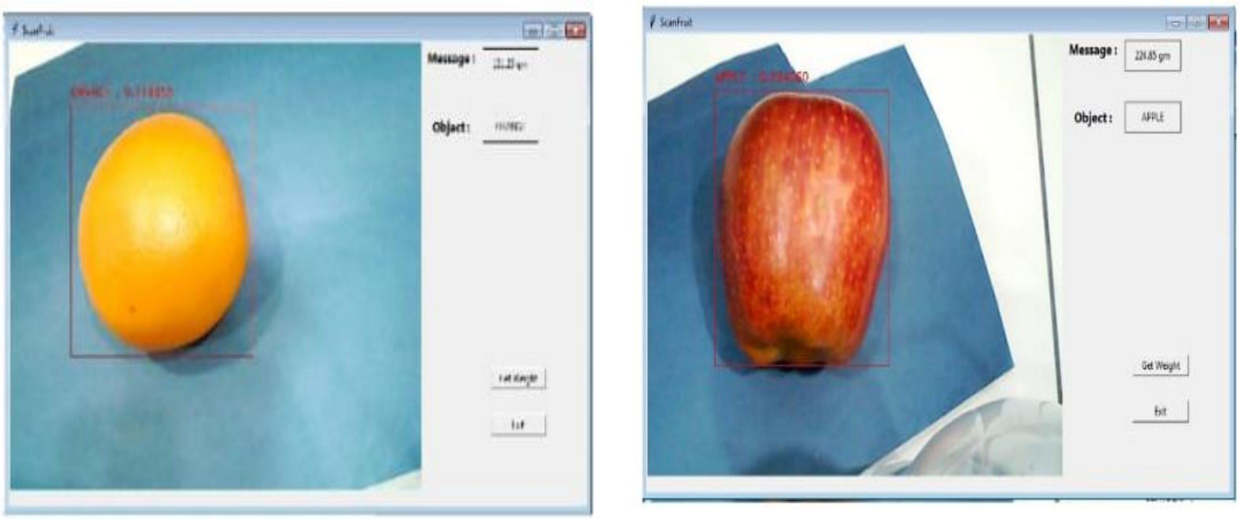

Figure 7- Item identification and weight system

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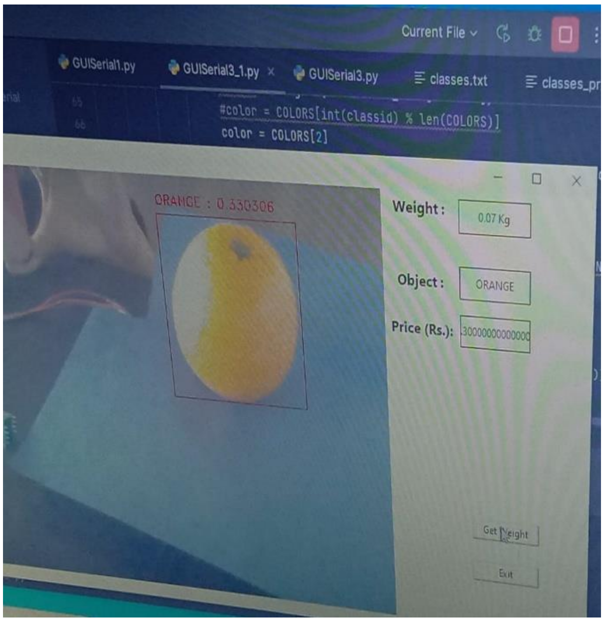

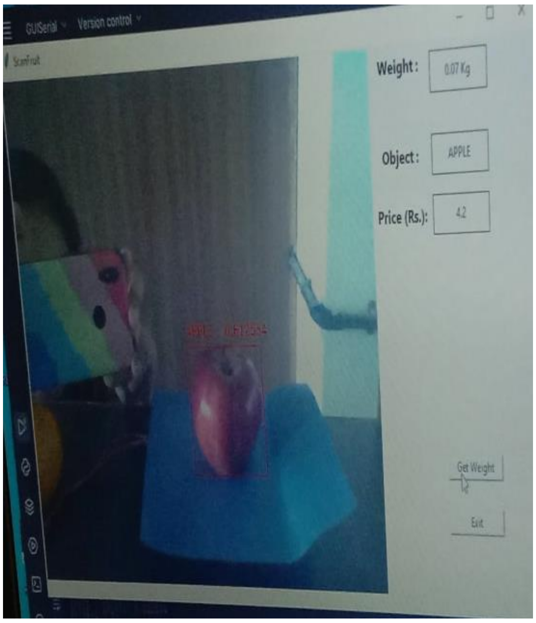

Figure 8- Item Identification and Automatic billing

5. Conclusion

Here, we effectively utilised camera and YOLOv4 to automate billing on the digital tram. Typically, technologies that make it simpler for physical things to exchange information are pricey. These were the issues that this programme tried to address and resolve. This clever cart will include an LCD that will show the automatically generated billing amount. It is reasonably priced. The installation of a navigational device that will identify necessary items depending on the consumer's location is the future expansion. When it comes to the real application of this prototype, a broad-range RFID scanner could possibly be added along with camera we've used here. Although there has been significant recent progress in this field, it is still exceedingly difficult to enable such applications.

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