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AutoBilling System

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Abstract - ***The*** *AutoBilling system represents a significant leap forward in the retail industry, harnessing the power of machine learning and computer vision to redefine the shopping experience. Traditionally, barcode scanning has been the go-to method for product identification and billing, but it often proves time-consuming and labor-intensive for both customers and staff. By leveraging cutting-edge technology, AutoBilling eliminates the need for manual barcode scanning, offering a seamless and contactless alternative. Using sophisticated algorithms, the system swiftly detects and identifies products as they are placed on the counter, significantly reducing wait times at checkout. This not only enhances efficiency but also minimizes human interaction, a crucial consideration in today's health-conscious climate.*

Key Words: AutoBilling, retail industry, machine learning, computer vision, shopping experience, cutting-edge technology, contactless.

1.INTRODUCTION

AI-Driven Billing System is an AI-powered autonomous checkout system for retail stores that utilizes computer vision and machine learning to offer a faster and more efficient shopping experience. The system is designed to minimize human interaction in the store to keep shoppers and employees safe during the pandemic. The system works by using computer vision algorithms and machine learning models to visually detect and identify items placed on the counter-top.

The system is equipped with cameras that capture high resolution images of the products, and a deep learning model processes these images in real-time to recognize the products accurately. Once the products are recognized, the system automatically adds them to the virtual cart and generates an itemized bill. In addition to visual recognition, AI-Driven Billing System also utilizes a weight sensor to measure the weight of the items placed on the counter-top. The system uses this information to ensure the accuracy of the billing process and prevent any discrepancies. One of the most significant advantages of AI Driven Billing System is its ability to generate an instant bill.

2.RELATED WORK

This paper reviews the evolution of object detection from traditional methods to deep learning frameworks. It discusses the limitations of traditional approaches and highlights the advantages of deep learning in learning high-level features. The review covers various deep learning architectures, modifications, and specific detection tasks, with experimental analyses and future research directions provided [1]. The paper proposes a Hybrid PCA-SIFT-FREAK algorithm for 3D object recognition in an automated billing system. It balances accuracy and memory usage, offering advantages over traditional methods. Comparative study shows improved performance, with real-time application potential, achieving high recognition rates while reducing computation time and memory requirements. [2].

This paper outlines machine learning's dual focus on constructing systems that improve through experience and understanding the statistical laws governing learning processes. It highlights machine learning's evolution from a laboratory concept to a practical technology widely used in commercial applications, spanning various fields from AI to empirical sciences. [3]. This paper proposes a smart unstaffed retail shop scheme utilizing image processing with Python to enhance the shopping experience. By training an end-to-end classification model on a dataset of images containing various stock keeping units (SKUs), the system achieves accurate SKU recognition and counting, addressing limitations of traditional unmanned containers. [4].

This paper introduces MobileNets, a class of efficient models designed for mobile and embedded vision tasks. MobileNets utilize depth-wise separable convolutions to construct lightweight deep neural networks. The authors propose two global hyperparameters for balancing latency and accuracy, enabling model customization based on application constraints. Extensive experiments demonstrate MobileNets' strong performance across various applications including ImageNet classification, object detection, fine-grain classification, face attributes, and geo-localization. [5]. Considering the time constraints that it takes to store memory; OMCL is proposed with a Phase shift mechanism. Just doing this increases the performance by 86.1% but it also hampers the life of the system by a miniscule 3.4% [6].

3.PROPOSED METHODOLOGY

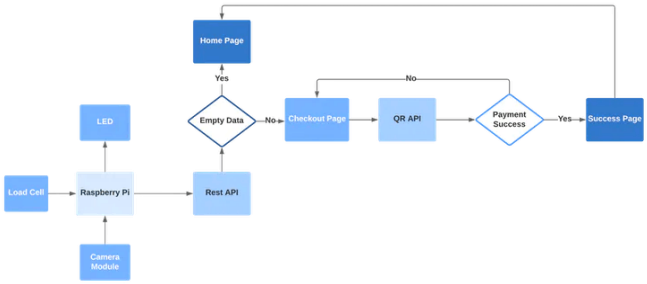


Figure 1: Flow chart

In the Flow chart, we can see the Raspberry Pi as a main controller with has been connected to the Load cell, Led, Camera module and API. The customer places the product on the load cell and the camera recognizes the product. This data is sent to the UI screen by using RESTAPI. Rest API helps to send data to the main screen where customers can see their product. In the main screen we have the home page and checkout page. Home page shows the product items and the details to the customers and Checkout page show the QR code, which helps the customer to pay for there product and checkout the screen. If customer wants to add more products they can just add the items and in the screen we can get the data of that products. After complete process of Checkout a success page is show up to screen, which said that successfully pay.

4. Workflow Description

As shown in fig. we can see the raspberry pi is receiving input from load cell and camera module at the same time giving output to LED to use it as flash to identify the objects or thing accurately.

The raspberry pi then sends the collected data to rest API for Billing and checkout.

The Rest API checks whether there is an empty data if yes it shows the home page and if data is not empty then it shows the checkout page with identified items, their prices and Total amount to be paid. Then shows QR API for payment if payment is completed then it shows the success page and goes back to home page and if payment is not done or failed it goes back to checkout page with item details.

OBJECT DETECTION

Edge impulse is one of the leading development platforms for machine learning on edge devices, free for developers and trusted by enterprises. Here we are using machine learning to build a system that can recognize the products available in the shops. Then we deploy the system on the raspberry pi 3b.

DATA ACQUISITION

To make the machine learning model it's important to have a lot of images of the products. When training the model, these product images are used to let the model distinguish between them. Make sure you have a wide variety of angles and zoom levels of the products which are available in the shops. For the data acquisition, you can capture data from any device or development board, or upload your existing datasets. So here we are uploading our existing datasets.

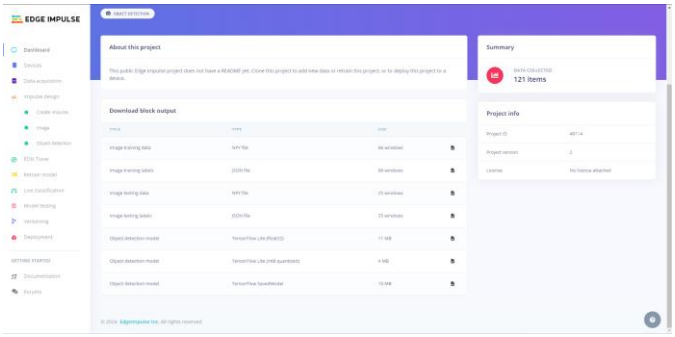


Figure-2: Data Acquisition

LABELLING DATA

The labelling queue shows you all the unlabeled data in your dataset. Labeling objects is as easy as dragging a box around the object, and entering a label. To make the life a bit easier we try to automate this process by running an object tracking algorithm in the background. If you have the same object in multiple photos we thus can move the boxes for you and you just need to confirm the new box. After fragging the boxes, click Save labels and repeat this until your whole dataset is labeled.

DESIGNING AN IMPULSE

With the training set in place, you can design an impulse. An impulse takes the raw data, adjusts the image size, and uses a preprocessing block to manipulate the image, and then uses a learning block to classify new data. Preprocessing blocks always return the same values for the same input, while learning blocks learn from past experiences.

CONNECTION OF RASPBERRY PI 3B+ WITH IMPULSE EDGE

The Raspberry Pi 3b+ is the powerful development of the extremely successful credit card-sized computer system. The brain of the device is Raspberry Pi. All major processes are carried out by this device. setting up the edge impulse with raspberry pi by using commands to connect the Raspberry Pi. After Raspberry pi 3b+ we have to connect the camera module and Load cell (hx711 amplifier).

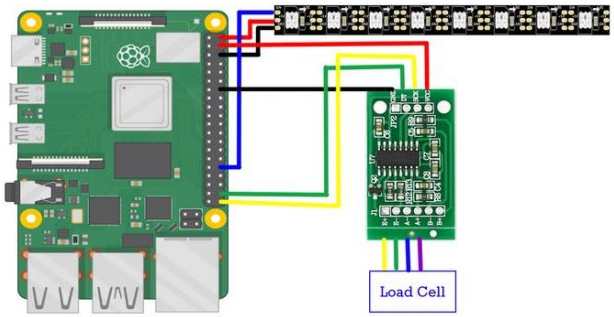


Figure 3: Raspberry pi 3b+ connection with load cell

FRONT-END USING HTML, JS

The front-end continuously checks for the changes happening in the back-end API and displays the changes to the user. Once an item is added to the API, the front-end displays it as an item added to the cart.

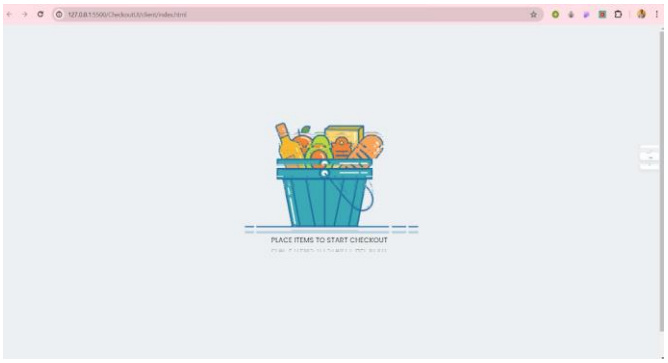


Figure 4: Front End Using HTML, JS

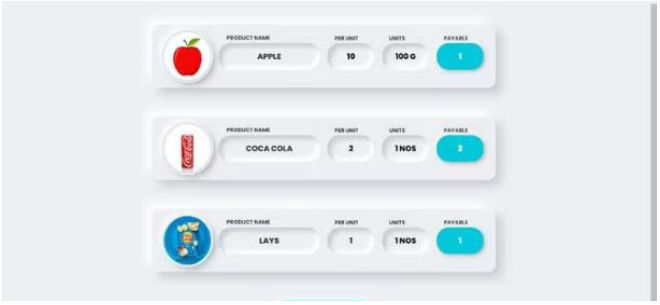
BACK-END USING NODE.JS, EXPRESSJS

The backend REST API is developed using Nodejs and Express. ExpressJS is one of the most popular HTTP server libraries for Nodejs, which ships with very basic functionalities. The backend API keeps the details of the products that are visually identified. for setting out the interface we have used a small tablet which has a touch interface with a small stand. Deploying the API on Heroku.

Figure 5: Back-end using NodeJS and Express on Heroku

5. RESULTS AND DISCUSSION

After training the model in edge impulse. The customer will place the product on the acrylic tray below that the Load cell will sense the weight of the product and above that camera, the module will recognize the product. All this data is sent to the Raspberry Pi 3b+ model. In the Raspberry Pi, we have a billing code with the API which sends the data to the UI screen. The UI screen can show the product detail their weight, price and photo. After the customer has the option to add to a card or just complete their buying and just pay off their buying. They have the option of adding to a card and paying using a QR code. The QR code shows to pay for the product. After completing successful pay they get the msg of paid bill.



https://www.electronicwings.com/users/CodersCafeTech/projects/2466/autobill

Figure 6: Checkout page

6. CONCLUSION

The proposed work namely "AutoBilling System" started with the need of a billing system for an conclusion, the use of artificial intelligence (AI) and computer vision in the retail industry has the potential to significantly improve the billing process, leading to increased efficiency, accuracy, and customer satisfaction. By leveraging deep learning architectures for object detection and image processing, we can automate the identification of products and generate bills in real-time. Additionally, by using machine learning algorithms, we can optimize pricing strategies, reduce inventory costs, and personalize promotions based on customer behavior and preferences.

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