AI Based Automatic Billing System

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Abstract

Over the past few years, demand for quick, accurate, and transparent billing mechanisms has developed exponentially across many sectors. Conventional billing systems tend to falter under lengthy wait times, manual mistakes, and inefficiencies, particularly in busy settings like retail outlets and utility services. This paper presents Auto Bill, a machine learning-based automatic billing platform that uses computer vision, machine learning, and embedded systems to automatically identify products, calculate prices, and process payments. Auto Bill uses sophisticated image recognition techniques in combination with weight sensors to scan and analyse products in real-time. Although tailored initially for use in retail applications, the system also finds application in areas like energy and water utilities, where it identifies consumption patterns and produces precise bills from real-time information. Mobile payments and web portals provide extended customer interaction by presenting customers with real-time billing details and transaction records. Auto Bill also supports contactless billing, which is in line with health and safety needs of today's world. This article covers the design, development, and impact of Auto Bill on the industry, noting its efficiency to enhance operation, customer satisfaction, and business decision making based on data.
Keywords: *Automatic Billing System, Raspberry Pi 3ModelB+, Load Cell, Camera Module, Hx711, Picamera, TensorFlow Lite, Flask, Edge Impulse, Fruit Detection.*

1. Introduction

With accelerating developments in embedded systems, machine learning, and artificial intelligence, the retail sector is presently experiencing a massive overhaul. Latest customers demand quicker, smoother, and more efficient shopping processes. Conventional billing systems, which are based on manual scanning and human interaction, usually cause long queues, human errors while scanning, and unhappy customers. Against this, AI-driven automated billing systems have emerged to fill these cracks through checkout automation, reducing the role of humans, and enhancing customer experience in general. These systems integrate such technologies as computer vision, image processing, and weight to identify products, set prices, and record transactions without barcodes or manual entries. Waiting time as well as potential human error are thus significantly reduced, making it easier for retailers to operate as well as providing ease for consumers. The worth of contactless transactions has only grown stronger since the COVID-19 pandemic, which was all about reducing physical interactions when making a purchase. AI-based billing systems enable customers to put products on sensor-enabled platforms or trolleys that read and monitor products automatically, promoting safety and convenience. Further, AI-driven billing systems make retailers better informed through customer behaviour and purchase pattern analysis in real time. This information facilitates better inventory management, correct demand prediction, and customized marketing, which results in increased profitability and resource optimization. Furthermore, the integration with online payment portals seamlessly streamlines the customer checkout process. In this regard, our system, Auto Bill, utilizes state-of-the-art technologies like deep learning algorithms, visual recognition models, and weight sensors to automate billing. As compared to conventional systems reliant on barcodes, Auto Bill recognizes products via object detection through

visual features and checks for quantities through weight sensors. The system has a simple and intuitive user interface showing live billing information, enhancing transparency and developing customer trust. With automation transforming the face of the retail sector, systems such as Auto Bill are a major step toward increased operational efficiency and customer satisfaction. This paper delves into the design, implementation, and future possibilities of automatic billing systems powered by AI such as Auto Bill.

2. Literature Survey

2.1. Survey of Smart Billing System

- **Authors:** Dr. Mary Cherian, Disha Dh, Chaithra KB, Ankita, Aishwarya
- **Journal:** International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), Vol. 5, Issue 5, May 2017
- **DOI:** 10.15680/IJIRCCE.2017.0505056

This paper proposes an Al-powered based Smart Billing System designed for amazing shopping experience. The system utilizes an Raspberry-pi for core processing. The System combines the power of computer vision and machine learning to provide an amazing shopping experience. The system provides a faster checkout experience to minimize human interactions in the store to keep shoppers and employees safer during the pandemic.

2.2. Survey of Autobill Generator

Authors: Parth Devardekar, Soham Sawant(2024)
Consumer demand is building as technology advances and there are new innovations in the areas of machine learning, artificial intelligence, and the Internet of Things. As life is going fast, the aspirations of people are also increasing. You don't have time to stand for long hours to complete the job. We illustrate an intelligent work employing the Raspberry Pi controller. Shopping carts are coded to record the cost of the goods loaded into them and transmit the final bill to a web application that can be accessed through phone or handheld. The system also prevents shoplifting and does not permit the customer to move items without paying.

2.3. Survey of Image recognition-Based Billing System

Authors: - Anas Usmani, Abhinav Pandey(2024)
This work describes a system that automatically does the billing of fruits in the retail market. Smart billing system is used for identifying and classifying the fruit types and to calculate the bill amount based on the type and quantity of fruits purchased by the consumer. Fruit identification is done using image processing technique and for weight measurement a load cell is used in the smart system. In this system an SVM classifier is used for fruit recognition. This smart billing system analysis and classifies fruits successfully and bill calculation is performed accurately.

2.4. Survey of AI Driven Billing System

Authors: - A Vennila, S Balambigai, G Deepa, M Ilakkia.(2024)
Project AI driven billing system was designed to transform the retail sector by employing machine learning and computer vision technologies to detect objects. Shopping is a necessity in life, and retail outlets are a significant source of products and services to customers. Barcode scanning is a widely employed tool for product recognition and billing within retail outlets. It has the drawback of being time-consuming and labour-intensive. The system, which is driven by AI, provides a quicker and contactless shopping experience for consumers, reducing human contact and wait times.. The system incorporates Mobile Net TensorFlow, an efficient and lightweight convolutional neural network model, to improve computational efficiency and scalability. The system can accurately detect products and prices, making the billing process faster and more efficient. Overall, the AI billing system offers a new and exciting approach to retail billing, providing a faster and more efficient shopping experience for customers.

2.5. A Literature Review on Billing System using Machine Learning

Authors: - Dr. Mary Cherian, Disha DH, Chaithra KB, Ankita, Aishwarya (2024)
The process of billing a product in a retail outlet is done using the system of pre-made barcodes or RFIDs. This is done to keep a track of the items and identify them in the billing process, but it is time-consuming and labour-intensive as all items need to

be affixed with barcodes before being used. Most of the small to medium scale retail stores also have a large part of their sales with items of a variable quantity, which cannot be affixed with barcodes as their quantity is determined dynamically and according to the customer's needs. In this paper, we have explored various technologies including but not limited to computer vision, object detection and image recognition, especially due to its latest boom with machine learning and deep learning. We have briefed our findings on technologies that can be used to build efficient and novel systems to solve the issues that arise with using systems that are labour intensive, redundant, time-consuming and explore ways to incorporate items that can be packed with variable quantities.

2.6. A Review on Automated Billing for Smart Shopping System Using IOT

- **Author:** Priyanka Sahare
- **Publication:** Review of Computer Engineering Studies, Vol. 6(1), March 2019
- **DOI: 10**.18280/rces.060101

A shopping mall is a form where wide variety of product items is available. This product can be clothes, beverages, books or food any domestic product. The main intention of supermarkets is to provide availability of all the items and save the time of the purchaser but sometimes purchaser gets discontented while waiting in the queue at cash counter and sometimes they get frustrated while balancing the total price of all the products with the budget in the pocket before billing. To swamp these problems, Shopping malls use this technique as a strategy to increase the number of purchasers. In big cities, we can observe an enormous flash at shopping malls on weekends. This becomes even more when there is diversity of offers and discount. Now a day's people buy a variety of items and put them in the trolley. After total buying one should approach counter for billing purpose. By using reader the paymaster prepares the bill which is a tedious process. This results in long queues at the cash counters. This project presents an idea to develop a system in shopping malls to conquer the above problem. When purchaser puts any item in the trolley its details will be recognized automatically, the item

name and rate will be displayed on the LCD Screen, thereby the rate gets joined to the final bill. If a purchaser wishes to extract the items from the smart trolley, purchaser can take away the product and the price of that particular item gets subtracted from total amount and the same information passes to the central billing unit via GSM module.

2.7. Smart Billing System

Smart billing system brings the strength of computer vision and machine learning together to offer a wonderful shopping experience. It offers a quick checkout shopping experience to reduce human interactions within the store to help shoppers and employees stay safer amid the pandemic. After identifying the items, things get added to the cart automatically and the bill instantly. QR code for payment is made, where users can pay their bills quickly and safely by just scanning the code using their mobile phones. Avail the future of shopping with Smart Billing System, where safety converges with efficiency to provide an unrivaled shopping experience.. This paper proposes an Al-powered based Smart Billing System designed for amazing shopping experience. The System combines the power of computer vision and machine learning to provide an amazing shopping experience. The system provides a faster checkout experience to minimize human interactions in the store to keep shoppers and employees safer during the pandemic.

2.8. AI-Powered Auto Billing System

- **Author:** N. Nekhil Ravi
- **Published:** February 21, 2022

This paper outlines an intelligent billing framework using Raspberry Pi, machine learning, weight sensors, and computer vision. It begins by surveying the integration of AI into billing processes—tracking how machine learning and pattern recognition have advanced accuracy and automated computations. Then it reviews existing Raspberry Pi applications in automation, discussing both their potential and practical challenges. The authors emphasize optimization techniques: reducing errors, speeding up calculations, and enhancing customization, especially when integrating with inventory or CRM systems. They highlight benefits—automating billing eliminates manual data entry, accelerates bill

generation, and minimizes human mistakes, making retail and small-business environments more efficient.

2.9. Automatic billing system by using AI

- **Authors:** Mary Cherian, Disha DH, Chaithra KB, Ankita, Aishwarya
- **Journal:** International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5(5), April 2020
- **DOI:** 10.15680/IJIRCCE.2017.0505056

In the past few years, automated bills in supermarkets have emerged and had significantly affected traditional shopping methods. In this pandemic situation, unmanned billing plays an important role, it can greatly affect the user's shopping experience and help contact-free shopping. This paper is mainly focused on the automation of the supermarket billing process. Traditionally barcode scanners and Radio frequency identification is used in the billing process but these methods have certain limitations. In present work, an alternative method is proposed to overcome these limitations. Object detection by using artificial intelligence can be utilized in billing automation since it is fast, accurate, and cheaper in operation than traditional methods.

2.10. Automatic Billing Trolley System Using Rasberry Pi

- **Authors:** Santhosh V, Gokulakrishnan D, Purushothaman S, Suganthi SU
- **Journal:** International Research Journal on Advanced Engineering Hub, Vol. 2(4), April 2024
- **DOI:** 10.47392/IRJAEH.2024.0137

As the technology is developing and seeing new inventions in various fields including machine learning, artificial intelligence, internet of things and so on, there is an increase in the expectations in the consumer point of view. With the fast moving lives, the consumers absolutely have no time to stand in long queues in order to get their work done. In this project, we are presenting a smart shopping system using RFID and Raspberry Pi controller. The trolleys in the shopping malls are protocol so as to automatically bill the products put into them and the final bill is sent to a raspberry pi which can be accessed at the billing counter. The word smart is trending lately in the field of IOT. Every object around us is being made smart so as to make our work easier. With the increase in internet technology, food items are available at our door steps whenever needed. But the experience of going to a mall and shopping the things all by our self has its own advantages and disadvantages as well. The advantage is that we can carefully select the best product according to our choice and judge the product by seeing, touching and feeling it. The major drawback of this is standing in stretched out line of customers for paying off the bill. The brought forward smart shopping structure avoids this drawback and also has additional features for the convenience of the consumer. The intensified Smart Trolley System helps the customers in minimizing the considerable amount of time that customers used to spend in shopping.
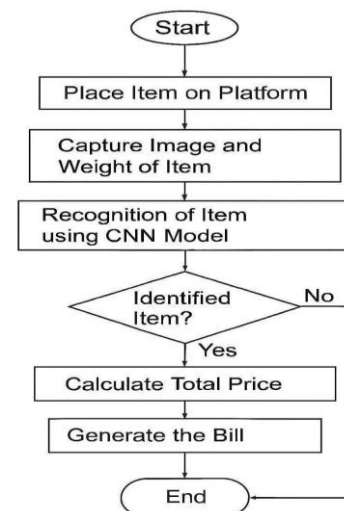

Figure 1 Flowchart

The Figure 1 flowchart illustrates the process of identifying and pricing item using a system that incorporates image recognition and weight measurement. The procedure starts with putting the object on a platform, after which an image is taken and weighed. A Convolutional Neural Network (CNN) model is employed to identify the object. If the item is successfully identified, the system

calculates the total price and generates a bill.
If the item cannot be identified, the process ends.

- **Start:** The process begins.
- **Place Item on Platform:** A item is placed on a designated platform, likely connected to a weighing scale and camera.
- **Capture Image and Weight of Item:** The system captures an image of the item and records its weight.
- **Recognition of Item using CNN Model:** The image is processed using a CNN model to identify the type of item. CNNs are commonly used for image recognition tasks.
- **Identified Item:** A decision point. If the item is recognized, the process proceeds to calculate the price; otherwise, it ends.
- **Calculate Total Price:** Based on the identified item and its weight, the system calculates the total price.
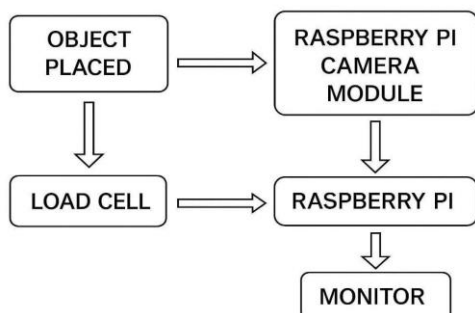

Figure 2 Block Diagram

The figure 2 block diagram illustrates an AI-powered automatic billing system, which uses a Raspberry Pi 3 Model B+ as its core. The system incorporates several components:

- **Camera Module:** Captures images of the object being billed.
- **Load Cell:** Measures the weight of the object.
- **HX711 Amplifier:** Amplifies the signal from the load cell for accurate weight measurement.
- **LCD:** Displays the billing information.
- **Raspberry Pi 3 Model B+:** Processes data from the camera module and load cell, and controls the LCD.

The process works as follows:
1. An object is positioned on the load cell, and the camera module takes its photo.
2. The load cell scales the weight of the object, and the HX711 amplifier enhances the signal.
3. The Raspberry Pi reads data from the camera module and the HX711 amplifier.
4. Raspberry Pi processes the information, detects the object (based on AI algorithms), and determines the bill based on weight and product data.
5. Billing data is shown on the LCD.
6. Raspberry Pi 3 Model B+ is the central processing unit, controlling all the other components. It executes the AI algorithms used for object recognition and controls the overall billing process. The system is intended for automated billing in retail or other settings where there is a need to have fast and accurate billing, shown in Figure 3.
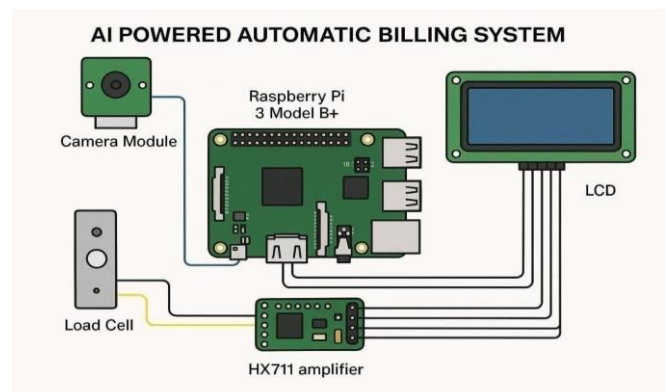
Figure 3 Circuit Connections


Figure 4 Results

Table 1 Results

Sr. No	Fruits	Training Number	Testing Number	Correct Recognition Number	Recognition Rate
1	Apple	1616	400	349	87.3%
2	Banana	1623	396	371	93.7%
3	Carambola	1103	276	267	96.7%
4	Dragon_fruit	1312	330	325	98.5%
5	Green_apple	536	136	118	86.8%
6	Guava	1666	417	319	76.5%
7	Kiwi	2254	567	565	99.6%
8	Mango	2209	544	439	80.7%
9	Muskmelon	1063	270	221	81.9%
10	Orange	1596	417	364	87.3%
11	Peach	1428	343	324	94.5%
12	Persimmon	1081	274	260	94.9%
13	Plum	1202	289	265	91.7%
14	Pomegranate	1157	282	257	91.1%
15	Tomato	1094	272	247	90.8%
16	White_pear	2707	657	485	73.8%

The connection of the Raspberry Pi with a camera module is one of the easiest yet most capable configurations employed in numerous AI and image processing applications. The camera module is connected to the Raspberry Pi via the Camera Serial Interface (CSI) port via a flat ribbon cable. It's best to power down the Raspberry Pi when attaching the camera to avoid any damage. After being connected, the camera must be activated using the Raspberry Pi configuration utility. This involves typing the command sudo raspi-config, moving to Interfacing Options > Camera, and choosing "Enable." Following the enablement, a reboot is needed for the settings to become active. In the picture shown, the Raspberry Pi has been interfaced with a camera module successfully. The terminal displays the usage of the raspistill command (raspistill -o pi.jpg) to capture an image and save it with the file name pi.jpg. The image captured is displayed on the screen in an image viewer, and it is ensured that the camera works as expected. This configuration enables the Raspberry Pi to record real-time images, which can subsequently be utilized in machine learning tasks like object detection, facial recognition, or automatic billing systems. It is a necessary gadget for AIbased embedded projects, shown in Figure 4.

- **Item Placement:** The user puts an item (e.g., product, vegetable, or fruit) on a platform. The platform comprises: A load cell for weighing the item. A camera module (e.g., Raspberry Pi Camera) to take a snap.

- **Data Acquisition:** weight information is transmitted from the load cell to the Raspberry Pi. The camera module records the image of the product and transmits it to the Raspberry Pi also. Item Recognition Through AI (CNN): A Convolutional Neural Network (CNN) model treats the input image and passes it through the steps to recognize the item based on visual attributes. This identifies the item (e.g., apple, banana, orange), shown in Table 1

- **Price Calculation:** Once the item is identified and weight is known, the Raspberry Pi: Matches the item with its price per kg/unit. Multiplies it with the weight to get the total price.

- **Bill Generation:** The Raspberry Pi generates the bill automatically. The bill can be displayed on a monitor, saved digitally, or printed.

- **Display:** All information (item name, weight, price, total) is shown on a monitor for user confirmation.
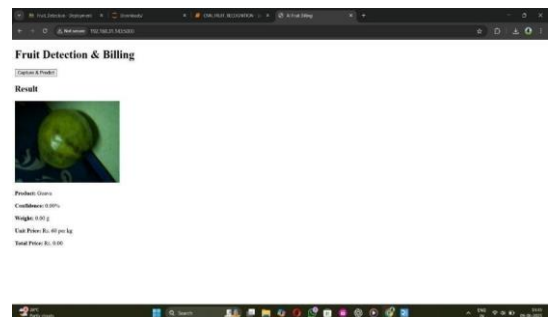
Figure 5 Model
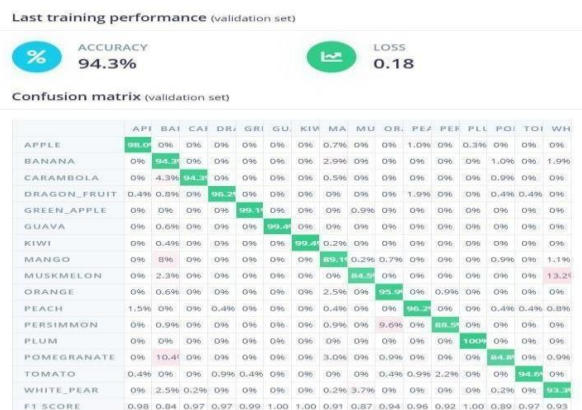
Figure 6 Confusion Matrix

3. Future Scope

The Auto Bill system offers immense scope for future development and implementation in different industries:

- **Retail and Supermarkets:** Automatic billing counters eliminate queues and manpower requirements.
- **Smart Shopping Carts:** Sensors enable real-time billing as a customer shop.
- **Advanced AI Models:** Enhanced object detection accuracy even with intricate product layouts.
- **Warehouse Automation:** Billing, packaging, and inventory tracking done by machines.
- **Cloud Integration:** Centralized analytics, inventory management, and multiple location support.
- **Sustainability:** Paperless billing and minimized resource usage, shown in Figure 5 & 6.

4. Application

Some real-world applications are:

- **Smart Vending Machines:** Automatic item recognition, weight confirmation, and billing.
- **Self-Checkout Stations:** Weight and vision-based contactless retail checkouts.
- **Pet Feeding Systems:** Automatic food dispensing and billing through app-based payment.
- **Library Checkouts:** Automatic book recognition and billing for overdue charges.

Conclusion

The AI-driven automatic billing system presented in this paper is a major leap forward in billing automation. Through the combination of camera modules, load cells, amplifiers, and Raspberry Pi-based CNN models, the system provides a fast and effective alternative to conventional manual billing. The system's capability to minimize errors, save time, and improve customer experience proves the potential of combining AI with embedded hardware. With advancing technology, systems like Auto Bill are set to become indispensable components in today's retail, utility management, and more.

References

[1]. Autobill Generator Using Raspberry Pi Bhavan Patil1, Bhakti Pote2, Vaibhav Sutar3, Vijaya Khairnar4, Jyoti Gurav5.

[2]. Autobilling System Anas Usmani1, Abhinav Pandey2, Pratham Solanki3, Rahul Yadav4, Zainab Mizwan5 Shree L R Tiwari College of Engineering, Mira Road.

[3]. Smart Billing System 1Parth Devardekar, 1 Soham Sawant, 1 Prasanna Gulavani 1 Karan Khot.

[4]. Ai Powered Auto Billing System Using Raspberry Pi D. Mahesh Kumar1, Boddula Pooja2, Dasari Sowmith 3, Polam Rakesh 4, Dugyala Deepthi5.

[5]. Image Recognition Based Billing System For Fruit Shop Using Raspberry PI To Cite This Article: A Vennila Et Al 2021 IOP Conf. Ser.: Mater. Sci. Eng. 1055012030.