Automated Shopping Trolley for Super Market Billing System

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***Abstract*- This paper implements a method to reduce the time consumed while billing in shopping mall. This model is based on Raspberry Pi-Processor with a PI Camera, Gear Motor and QR scanner. PI camera will capture the video which will have many images. Each image will have different value like 189, 170, 52, 0 and many more. If the image value "0" is detected with the help of image processing technique, it will start moving toward the customer. Each coming image value will be displayed on the running of Program. Web Page will be designed for the customer registration and shopping mall main page. Every customer will be registered to get their login ID. All purchased items detail can be seen to their respective login page. Trolley will be following the customer automatically as and when customer moves in any direction with the help of pi camera and gear motor.**

***Keywords*: Raspberry-pi, PI camera, QR Scanner, Shopping mall, Image processing**

I. INTRODUCTION

In the modern world, every supermarket and hypermarkets employ shopping baskets and shopping trolleys in order to aid customers to select and store the products which they intend to purchase. The customer will have to scan the product and then put the product into the shopping trolley and then proceed to checkout at the billing counter. The billing process is quite tedious and highly time consuming and has created the need for shops to employ more and more human resource in the billing section, and yet waiting time remains considerably high. So this model "Automated Shopping Trolley for shopping market billing system" will reduce and possibly eliminate the total waiting time of customers, lower the total manpower requirement and expenses for markets and increase efficiency overall. The Automated Shopping Trolley is a Smart Trolley which integrates a Raspberry Pie Embedded Chip with one Bar code Scanners, four gear motor and a Battery kit [1]. Every customer will be registered to get their login ID. All purchased items detail can be seen to their respective login page. Trolley will be following the customer automatically as and when customer moves in any direction with the help of pi camera and gear motor. It is an innovative product with social acceptance which will aids the comfort, convenience and efficiency in everyday life. Schematic diagram is shown in Figure 2.1.

II. WORKING PRINCIPLE

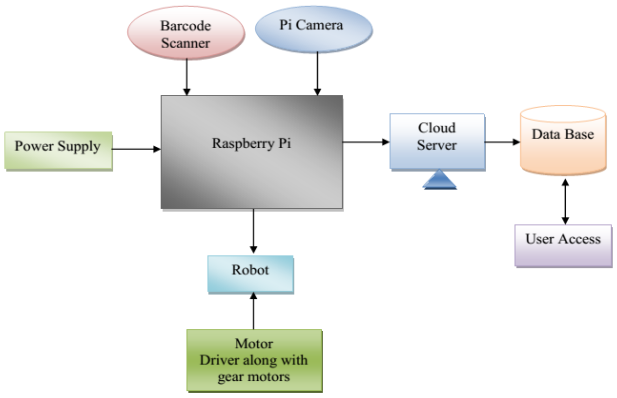


Figure 2.1 Schematic diagram

A. Description

The System introduces an object based tracking robot which is driven by wheels and controlled by a computer along with software. The objective of this paper is to design a robot which is automatically controlled by computer to track and follow an object. Image acquisition by the robot is achieved by a pi camera, and then it is sent to image processing software for further processing.

This paper describe an object detection by the trolley with the help of PI camera, IR sensors, and image processing technique which is used in the field of robotics for identification and tracking of the object. Blob detection methods are aimed at detecting regions in a digital image that differ in properties, such as brightness or color, compared to surrounding regions. In an image some properties

are constant or approximately constant. Object is nothing but any living or non-living thing, and the word detection stands for identifying the object once known to the camera as input.

Trolley consists of Raspberry pi, and Motors which are interlinked. Image of the object is captured using the Pi camera. Image captured by the camera will be forwarded and processed by the Raspberry pi [2]. Raspberry processor will apply several image processing algorithms and detect the object. An external IOT is connected to the processor for the linkage between android device and raspberry pi. 10 rpm motors are used and they will follow the instructions properly given by the processor by keeping minimal distance

B. Data flow diagram

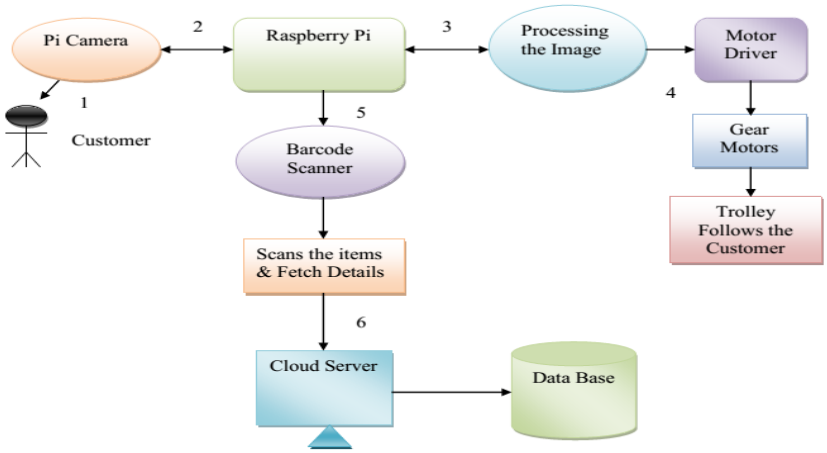


Figure 2.2 Flow diagram

1. Pi camera captures image of the customer.

2. The captured image is sends to Raspberry Pi.

3. Raspberry pi process and analyze the image captured by the pi camera.

4. Then the motor drivers activate and enable gear motors to follow the customer.

5. The customer picks the items and scans these items with the help of barcode scanner.

6. The scanned item details will be send to cloud server and stored it in the database

C. Image processing

Algorithm used is Harcascade Algorithm. It is the only Algorithm in order to detect the human related image processing. It involves five steps.

1. RGB to Grey conversion: Camera will capture the video of objects. Video will be segregated in to number of frames. Each frame will be in colour and hence its pixel value will be very close to each other. So we will be converting this coloured image to black and white format in order to detect an object.

2. Binarization: It will convert the captured image into data part and non data part with the help of the Grey scale image.

3. Erosion and Dilation: In this data part will be enhanced i.e highlited and non data part will be made blurred in the background.

4. Edge detection: If any part of image will be visible then also it will detect or follow the object.

5. Future extraction: The object detection process will be keep on happening in the background so that it should not follow any other object

D. Control flow chart

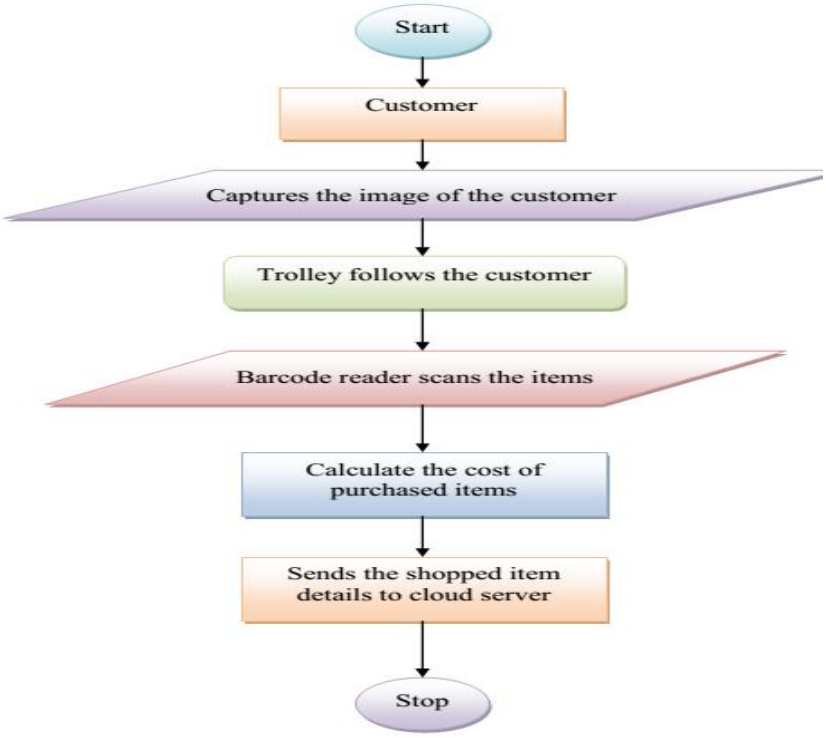


Figure 2.3 Control flow diagram

III. HARDWARE REQUIREMENTS

1. Raspberry-Pi microcontroller
2. Memory Card
3. Barcode Scanner
4. Pi-Camera
5. Gear Motor
6. IR sensors

A. Raspberry-pi microcontroller

Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation. The Raspberry PI includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU and it has 256 megabytes of RAM [3]. It uses a Micro SD card for booting and persistent storage. It is shown in below Figure 3.1.

Figure 3.1 Raspberry-pi model

There are 40 Pins on the model altogether. There are three power supply pins [3.3v, 5.0v and 0v]. It has 26 GPIO (General purpose input and output) pins. Raspberry-pi pin detail is given in below Figure.3.2.

Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1 , I²C)	DC Power 5v	04
05	GPIO03 (SCL1 , I²C)	Ground	06
07	GPIO04 (GPIO_GCLK)	(TXD0) GPIO14	08
09	Ground	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	Ground	14
15	GPIO22 (GPIO_GEN3)	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	Ground	20
21	GPIO09 (SPI_MISO)	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	(SPI_CE0_N) GPIO08	24
25	Ground	(SPI_CE1_N) GPIO07	26
27	ID_SD (I²C ID EEPROM)	(I²C ID EEPROM) ID_SC	28
29	GPIO05	Ground	30
31	GPIO06	GPIO12	32
33	GPIO13	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

Figure 3.2 Pin details of Raspberry-pi

B. PI camera

In order to meet the increasing need of Raspberry Pi compatible camera modules. Now a revised version of PI camera module for Raspberry Pi which is fully compatible with official one has come. The revised PI camera has good optical performance than the previous Pi cameras, and gives user a much clear and sharp image. Also it provides the signals which can be used for multi-camera synchronize capture with proper camera driver firmware [4]. It can be used by two Raspberry-Pi by one of the two small sockets on the board upper surface. Pi camera is shown in below Figure 3.3.

Figure3.3 Pi camera

C. Barcode scanner

A standardized identification peruses or scanner is an electronic gadget for perusing printed scanner tags. Like a flatbed scanner, it comprises of a light source, a focal point and a light sensor making an interpretation of optical driving forces into electrical ones. Also, almost all standardized tag peruses contain decoder hardware dissecting the standardized identifications.

D. Gear motor

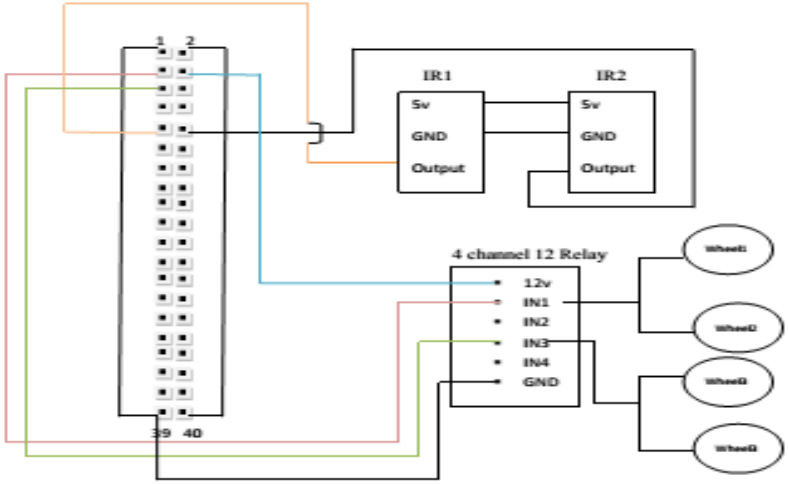
A small motor (ac induction, permanent magnet dc, or brushless dc) designed specifically with an integral (not separable) gear reducer (Gear head). This motor requires 12v DC power. With the help of Relay these motors are used to turn the trolley left or Right or forward.

E. IR sensors

IR sensors are used to detect the presence of an object. If the object is present then it gives signal to the camera to capture the video. Two IR sensors are used one is left side and other one is on the right side of the trolley. IR sensors are shown in Figure 3.6 below.

Figure 3.6 IR sensor

F. Circuit connection diagram



IV. SOFTWARE REQUREMENTS

In this section software used for this project will be discussed.

A. Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. It is high-level built in data structure. It is used for trolley movement and product scanning.

B. Raspbian jessie

It is an operating system for Raspberry Pi. There are several versions of Raspbian including Raspbian Jessie. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs. Raspbian is a free operating system for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi to run.

C. SQL

It is used to create a data base to store all the details of products and also the user ID and password for all customers.

D. HTML and JSP (Java Server Page)

It is used to create web page and to display all the details of all the purchased items on the login page of user.

V. RESULTS

This model will be following a customer (object) as and when customer moves forward, left, right with the help of four motors , four wheel , two IR sensors (for left and right), PI camera (fixed at centre) and program stored in Raspberry pi processor. Along with this it will also display the details of item scanned with the help of barcode scanner on the user login page.

A. Item Scanned

In below Figures list of item scanned during demo of model has been given below.

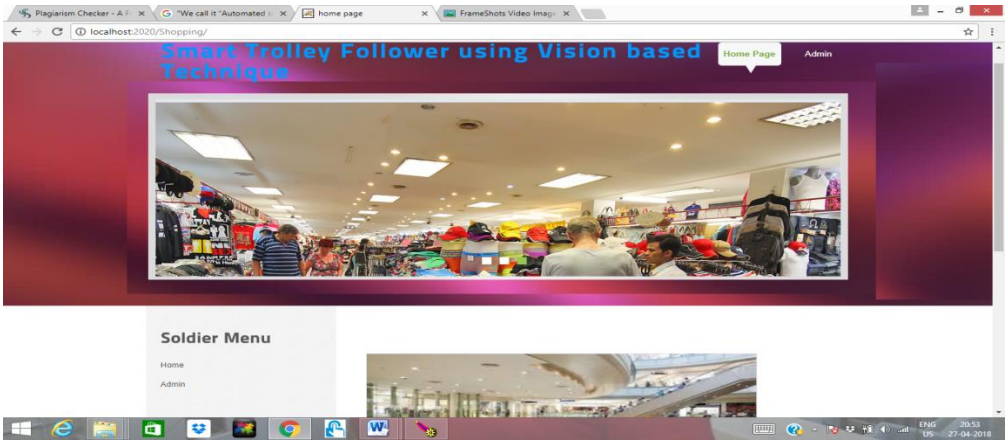


Figure 5.1 Web page created for shopping mall

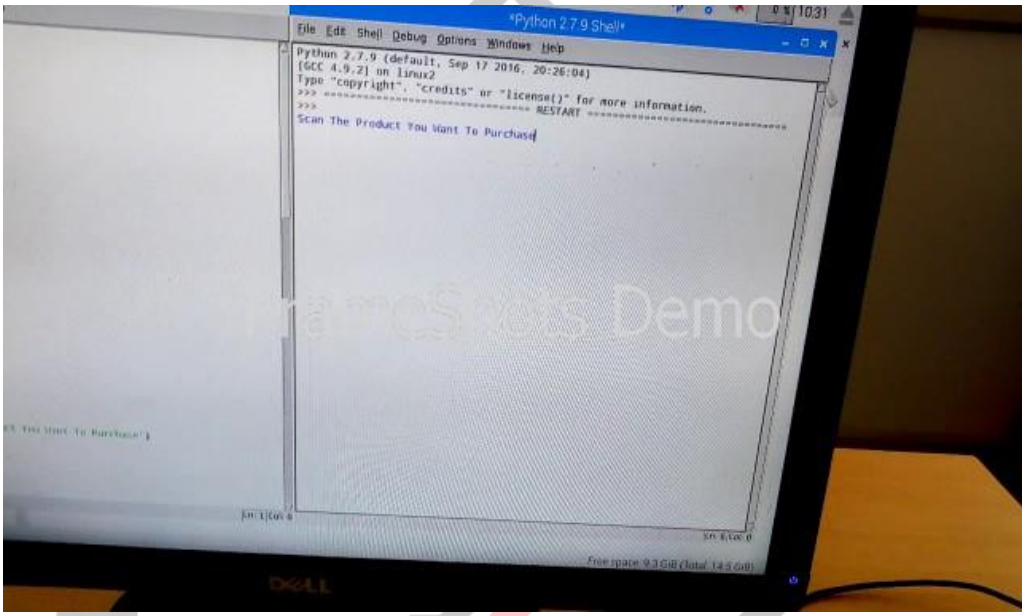


Figure 5.2 Before scanning the product

Figure 5.3 During scanning of product

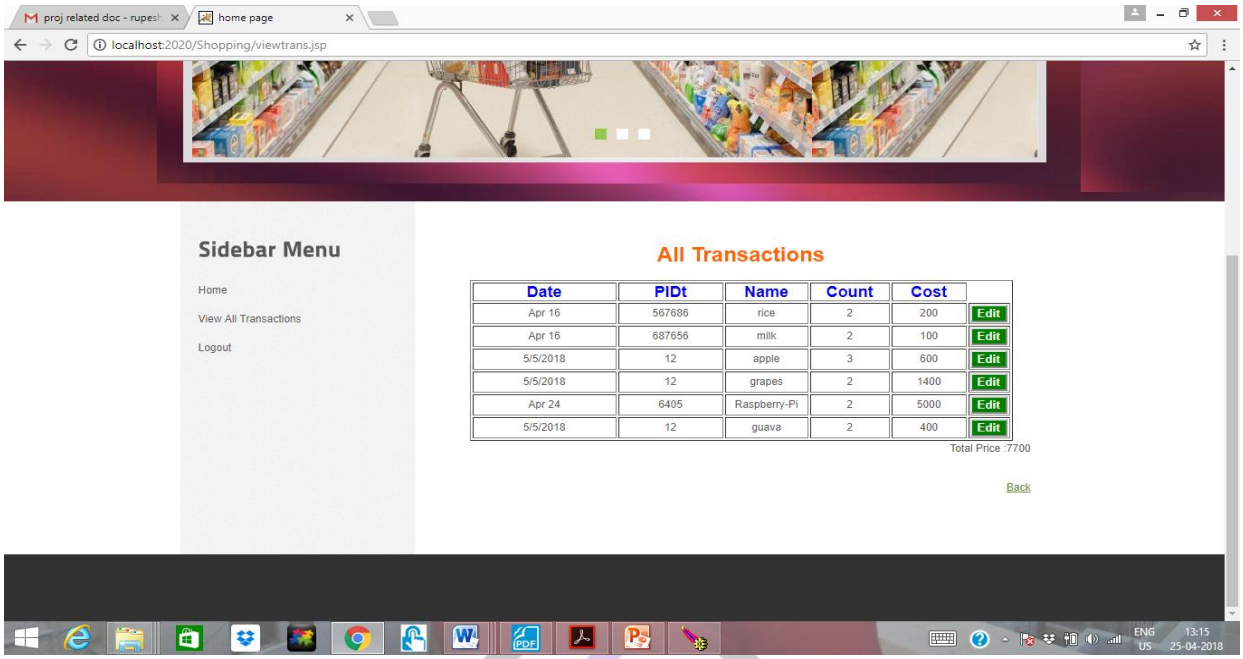


Figure 5.4 After scanning of products (product details)

B. Trolley movement

When the trolley moves forward/left/right/stop then "forward " /"Left"/"Right"/"Stop" message comes respectively during the running of program which has been shown in Figure 5.5 below.

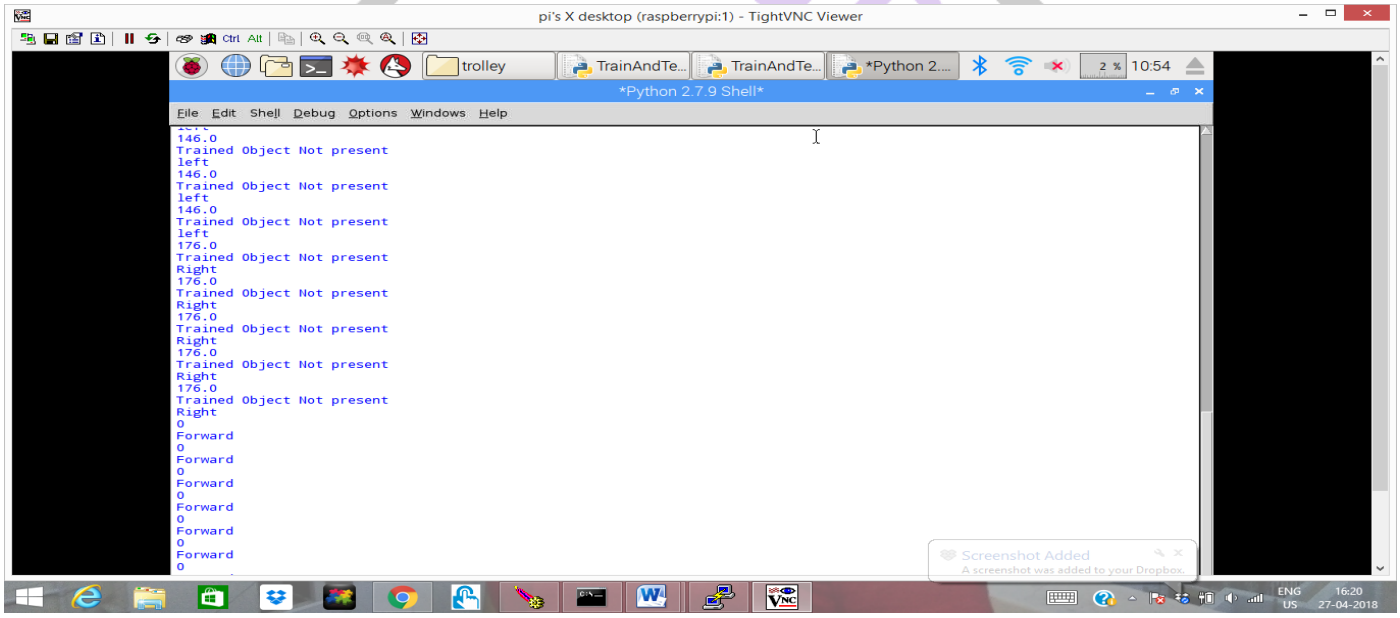


Figure 5.5 Trolley follows object (customer) movement and its details (like forward/left/right) is appearing on screen

VI. CONCLUSION AND FUTURE SCOPE

In Automatic Trolley, the Vision-based technique will help human in many ways including following him/her carrying load and reducing human effort. Likewise, it will also be helpful in removing the use of paper by sending all the item details on the user web page. Hence this model will be an aid toward garbage removal.It gives facilities like trolley stopping, turning left, and turning right. It is successfully implemented the concept of Automatic trolley. It reduces human effort and time required to perform the required task. Also it is efficient to use. Future scope can be overcoming problems like obstacles by using sensors. By using powerful battery and camea object present at a bit large distance can also be detected and same concept in different enterprise applicationscan also be used.

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