Capturing Supermarket Shopper Behavior Using SmartBasket

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Abstract. Retail stores make marketing decisions using customer demographic and sales data to determine which customer and product group combination best contributes increased profit. Customer profile and sales data are of great help but they alone do not portray the whole picture. Tracking the location of a customer in a store and analyzing the customer shopping path and marrying the result to customer profile and sales data is of high interest for marketing for the purpose of streamlining store operations, maintaining customer royalty and increasing sales. In this paper, we propose a system for supermarkets that tracks the path of a shopping cart associated with a customer profile to understand the customer shopping behavior. The proposed system uses IR LED plates installed on the carts which are monitored by small and inexpensive in-shelf networked IP cameras. The shopping carts are equipped with a low cost input device that has a monitor to gather customer profile information. The system is integrated with the supermarket's web site to customize the overall shopping experience. The data collected is mined to find out the relationships among product placement, customer profile and product purchase decisions. The system is designed to monitor real time movements of the shopping cart.

Keywords: Customer Tracking, Shopping Behavior, Navigation Patterns, Image Processing.

1   Introduction

Offering the right product, at the right price, in the right place and at the right time to customers is an elusive goal for retail owners. Detecting patterns in customer behavior and understanding the thought process in purchasing decisions is very helpful in gaining competitive advantage. Store owners want to be knowledgeable about their customers' profiles, the relationship between customer profiles and customer shopping habits and the products that the customers want to have in their stores. The amount of time a customer spends in a particular aisle and in which order they visit the aisles are

of particular interest to the owner. A supermarket owner is also keen on knowing if a product is drawing the attention of the customers or not. It is essential to separate a customer passing by a product group from a customer paying close attention to a product group, even though no purchasing activity has occurred in both. The former case is especially significant because the product simply goes unnoticed and maybe needing a relocation. In the latter, the customer has looked at the product group but chosen not to buy the product which may indicate that a product re-design or a price adjustment is due. Information of this kind is very valuable and cannot be obtained from cash register sales data. It requires tracking data.

Gaining an insight into customer behavior can be achieved by analyzing data from multiple sources. Our goal in this paper is to present a novel and cost effective solution to collect customer location data and combine this data with customer profile and purchase data to make inferences about customer behavior, hence to help the retail owner to develop effective marketing decisions and to determine future strategic direction. This provides a wholesome solution to supermarket business intelligence. The systems also improves the overall customer shopping experience by dynamically adapting customer services and offering individualized service based on customer profile.

Tracking data is collected using in-shelf IP cameras by detecting the IR LED plates installed on the cart. The system also includes a low cost electronic device with a touch monitor and an integrated barcode reader (similar to an entry level tablet PC). This device is also installed on the shopping cart to facilitate interaction with customers for creating their profiles and customizing their stay in the supermarket.

Smart Cart software is implemented using C# and .NET technologies. Processing of the frames is done using open source computer vision library OpenCV [1]. The System Architecture Section presents the architecture and implementation details of the proposed system.

2   Related Work

There are numerous techniques developed to track people and assets especially in inventory tracking and supply chain management [2]-[5]. Some of these are commercial products and some of them are still under development in research labs. One such commercial application from PLUS uses Ultrawide band technology to track people and assets in retail stores and grocery stores real time [6]. This technology can pinpoint the exact location of a customer but is very expensive. Shopper movement is tracked by a camera using face and eye detection in [7]. Computer vision based approaches do not require expensive hardware to implement but use advanced image processing algorithms. Therefore, these approaches do not easily lend themselves to real time monitoring as they require extensive back-end image processing. Their use in retail shops and grocery stores are not as widespread as in the case of RFID based deployments. RFID based solutions usually equip the carts and shelves with readers and store items with tags [8], [9]. The system described in [8] is a comprehensive