

## Understanding Customer Behaviour in Shopping Mall by Indoor Tracking and QR Identification

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### ABSTRACT

The prosperity of various indoor data tracking technologies makes possible for the large collection of tracking data in indoor spaces such shopping malls. Much of the focus has been on several fundamental problems such finding the ideal location, indoor shopping mall model, products requirements and understanding the patterns of shopping behavior of customers to facilitate higher growth in sales and to analyze strategies to efficiently manage the customer data, this paper attempts to analyze customer behavior from a unique indoor tracking data, which will promote the convergence between various applications and the underlying data. In particular, this paper uses the alternative method for indoor tracking and customer data by using QR code technology which uniquely differentiates each customer, collectively stores data and provides organized purchased product data, wherein we cluster users into several groups and summarize the most characteristic behaviors of each cluster. Last but not least, we analyze customer's individual behaviors through two aspects: 1) the K-means clustering algorithm is used to reveal concentrated region for the attributes required to analyze and 2) a summary of all the purchase data classified into categories required by user are generated.

**Keywords :** QR code, K-means clustering, indoor tracking.

### I. INTRODUCTION

In recent years, the data mining field has become a very important concept in business and marketing sector. One such sector is the shopping malls and complexes which require the analysis and understanding the customer purchase pattern and behavior towards the products. This paper aims to provide a concrete solution to analysis and tracking of customer behavior and its analysis using machine

learning. Although a considerable amount of research has focused on the management [1] and analysis of indoor tracking data [2], we still have a relatively limited understanding of the customer to become the loyal consumer behaviors in an indoor space (e.g., a shopping mall). To fulfill this crucial void, in this paper, we aim to introduce a unique indoor tracking technique with the help of QR code technology. Both the data and relevant analysis can serve as the building blocks of future study and applications which

can serve the purpose to generate maximum efficiency for the shopping malls from the data obtained from this paper. The usage of QR code technology [3] is implemented to allocate unique identification to each customer entering the shopping mall. All the purchases made by the Customer are recorded in the database by scanning the QR code at the time of purchase and linking it to allocated customer. The purchase details are then analyzed based on machine learning techniques to generate results which facilitate the growth of the shopping centers. This paper provides a combined solution to store customer data for marketing and to analyze it for better development of strategies and improvements in the business sector.

## II. LITERATURE SURVEY

In this section, we give a brief overview of several core issues involved in dealing with indoor tracking data and Indoor Localization. To obtain accurate positions of tracked objects serves as the foundation of other relevant issues. Over the past several decades, a variety of techniques have been proposed for indoor localization, which can be classified into two categories: active and passive. The former kind of techniques require tracked persons to participate actively, while the latter estimate the position based on the variance of a measured signal or video process. Since the former are able to capture the semantics associated with indoor entities and the movements enabled or disabled by such entities. In a separation of different space models into a multi-layered representation is introduced so as to reflect the internal structure of an indoor space as well as the characteristics of sensors and transmitters. Indoor Data Indexing. Given tremendous indoor tracking data collected by one or more techniques, numerous indexing methods have emerged to meet the demands for efficient and scalable spatial query processing. To cope with the challenges posed by various

applications, researchers have presented a variety of querying methods for indoor objects.

Some remarkable contributions in the survey of the Customer behavior analysis and related aspects are also included.[4] in his study mentioned Street markets in developing countries constitute an integral part and exhibiting the ethnic image of the habitat of the local economy. The shopping malls had intercepted the traditional marketplace culture and instrumental in shifting the consumer behavior in urban areas. In this paper discussed how consumer's decision-making styles shift towards shopping at mall. It concluded with specific suggestions for reducing conflicts and increasing cohesiveness with regard to shopping behavior between shopping malls and street markets. [4] strategically analysed the Indian retail industry. This identified the drivers which were affected the growth of the Indian retail market, looks at the major factors affecting the retail business and to carry put the SWOT analysis of organized retail in India. The results of the study depicted that infrastructure, economic growth and changing demographics of consumers were the major driver of organized retail in india. In this study stated location of the retail store, management style and adequate salaries to personnel enhanced the effectiveness of retail business. Some studies mentioned future competition between mall operators so they redefined nature of business. They sated Indian families shopping had become more of an emotional experience than habitual low involvement consumer behavior. The purpose of the paper was to examine the impact of entertainment facilities in Indian malls on shopping behavior. The researcher findings suggested that entertainment facilities in malls contributed to drawing traffic to Indian malls.[5] in their paper presented consumers satisfaction level as experienced by the shopping centre offer. They stated the relationship between shopping centre image attributes and the consumer satisfaction, loyalty, The Study results indicated specific shopping centre image

attribute were positively related to consumer satisfaction and loyalty. Consumer’s intentions were examined regarding potential shifts in their behavior due to economic crisis.

A bar code is an optical machine-readable representation of data related to the object to which it is attached. Originally barcodes systematically represented data by varying the width and space of parallel lines, and may be referred to as linear or one-dimensional (1D). Bar codes consist of bars and spaces that vary in width. The bars and spaces on a bar code correspond to numbers and letters that represent descriptive data. In 1994 Denso Wave5 started using a type of bar code for their robots industry. It spread over to the car manufacturing industry. We never really saw the potential that had QR Code technology. Unlike the standard bar code system in use today, QR codes are far more powerful and can contain much more information. While our current bar-coding system holds information only one-way, QR Code [6] holds into both vertically and horizontally. In comparing the current bar-coding system with QR Codes [7], we also note that QR Code is really about convenience. In order to access the information contained within our current barcode system, we need a special scanner. The type of scanner and system isn’t cheap. Therefore, you don’t see them in households and the system’s use continues to be restricted to retailers and larger businesses.

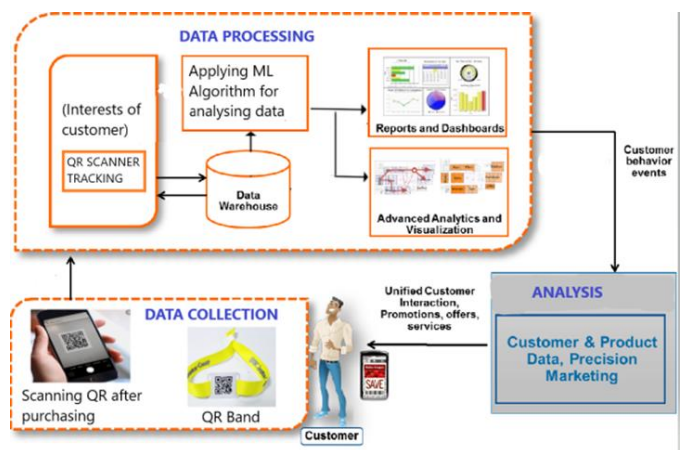
Multiple researches were made which contributed towards the development of what stands today as a solid foundation towards the development of this paper which marks the contribution from the previously conducted survey.

Research topic	Year and Specifications	Key points of project
Small town shopping center analysis	2010(prototype model)	Basic analysis using keyword
Overall Customer Satisfaction survey	2012 (survey)	Satisfaction analysis from customer perspective
Survey of facility management systems	2013 (survey and project design)	To develop new facilities for customers
Interest research software analysis	2016 (published result)	To determine the interest of customers in the mall
Understanding Customer Behavior in Shopping Mall from Indoor Tracking Data	2018 (base paper)	Analysis using machine learning and use of RFID indoor tracking

Literature Survey

### III. METHODS AND MATERIAL

#### A. ARCHITECTURE LAYOUT



System Architecture

#### B. MODULES

The system is divided into 3 modules which represent the data collection phase, the data processing and

manipulation phase and finally the output generation phase.

The primary data gathering phase begins at time when the customer enters the shopping mall. The person is allocated a unique custom generated QR code wrist band to carry along and present it while any purchase being made during their shopping journey in the mall. This generated unique code carries the Customer data which includes the name details, age, contact details and other required attributes which are linked to the QR code. This sets up the base structural layout in the database for all the customers which visit the shopping mall.

The customer provides the QR code for scanning at the indoor shop inside the mall which assigns all the product data to the scanned QR code. The Mall employee assigns the details for product(s) purchased by the customer along with the shop ID linked with it. The shop ID allows us to uniquely identify the indoor path and tracking data for the customer visited shops only where the purchase was made which generates the tracking data exclusively for shopping requirements of the customer and their pattern along choice of purchased products.

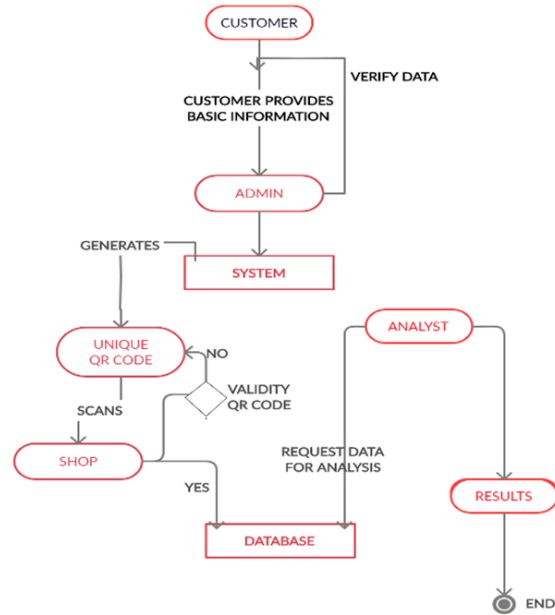
The data gathered provides the segregated data which includes all the history about a particular customer which can be accessed anytime for any assessment by the system admin which in this case will be the Mall analysts and manager. [8]

The Data gathered from all the customers is analyzed by using machine learning techniques and algorithms to obtain the pattern of customer behavior. The indoor tracking data is used to determine the best regions which are visited by the customers visiting the mall.

The graphical output is presented based upon multiple factors such age group, gender, amount spent, quantity of products, category of products purchased. Also, further study can be used to determine the time spent by customers in the shopping mall and the loyalty of customers based upon their purchase history

to decide advertisement campaigns as well as offers for specific customers.

**C. PROCESS**



Activity Diagram

**Abbreviation list**

- Q – QR code
- D – Individual Customer data
- S – Cumulative Customer Data
- P – Product Purchase Data
- S` - Product Data linked with Customers

**Module 1: Data Collection from Customer**

- Input D into S
- Check for all conditions
- If (true)
- Allocate Unique Q
- Else
- Re-enter D to S
- Generate Q

**Module 2: Product purchase data**

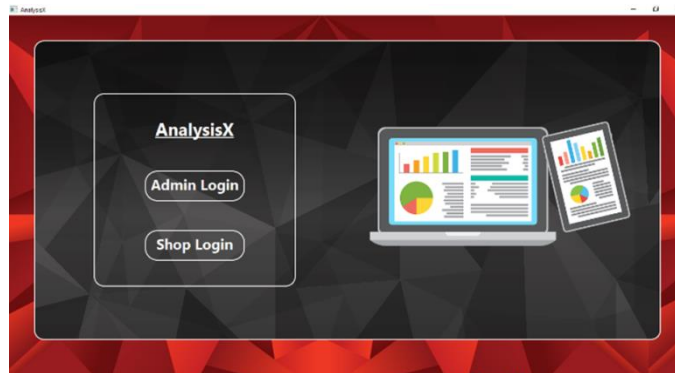
- Scan Q
- If (true)

Input P into S  
 Else  
 Rescan Q  
 Store into S  
 Generate S`

**Module 3: Result Generation**

Covert real-time data to Spreadsheet csv  
 Pre-processing S`  
 Apply K-means clustering algorithm on S`  
 Input S` to visualization tools  
 Generate graphical result

**IV. RESULTS AND DISCUSSION**

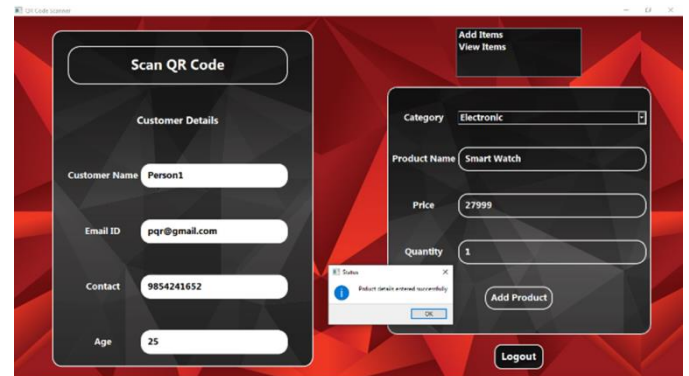


Home Screen

The home screen of application provides the login interface for shops and the administrator. The login page also includes a separate Signup window for each section with all parameters and details required for it. The features provided to each login section differ according to its required functionality.

The QR code generation and Analysis section is available to the admins only. This section enables the generation of new customer entries and automatic QR code generation. The QR code is also locally stored in the files for manual distribution.

All the associated functions which include modification, searching and deletion of QR code associated with the customer. The Analysis section provides a variety of graphical tools to analyze the database of customers and to reach a concrete conclusion. It also provides on-demand features which can be specifically configured according to the needs. The Analysis section is dedicated to obtain patterns in the numerous data elements of the customers. It helps in tracking the information of each individual customer as well as a cumulative group of customers and to understand their purchase patterns and behavior for the future purpose of advertisement and promotional offers which are customer-specific.

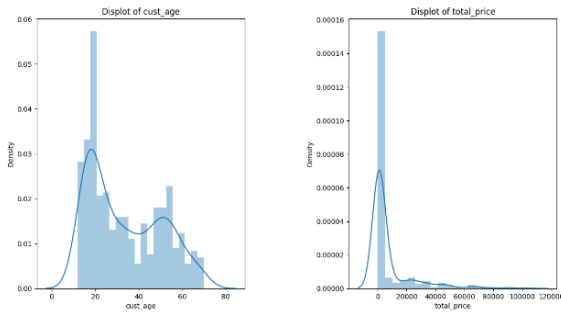


Scanning QR Code and Product Details Entry

The Scanning section displays the real-time scanned data of the QR code using a local camera device. The product purchases can be individually registered for each scanned customer using the uniquely allotted QR code. The history of purchases of each or a group of customers can be tracked here using specific filters.



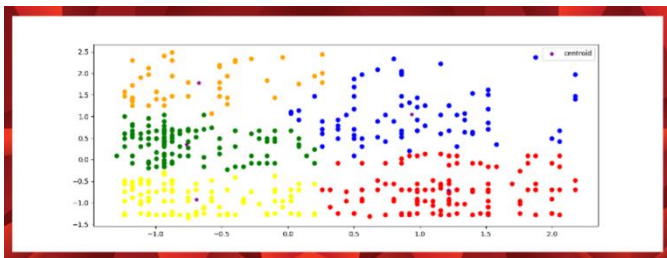
Data Entry and QR Code Generator



Density Graph

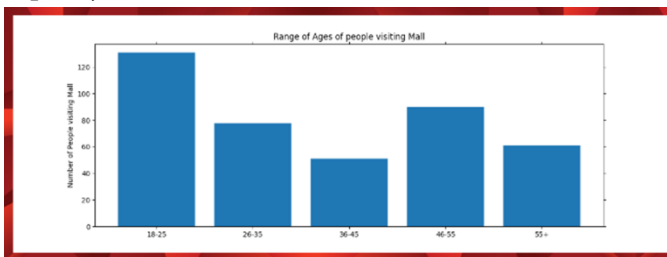
The chart uses unsupervised clustering techniques to visualize areas of varying density and to obtain the attributes for the region having the highest set values. Thus, we can conclude a particular attribute to be of maximum impact using it.

The values from the clustering plot can be used to improve the product pricing and to enable to efficiently manage the quantity for it. The clustering data is visualized into alternative forms for feature specific data.



Cluster formation using K-Mean

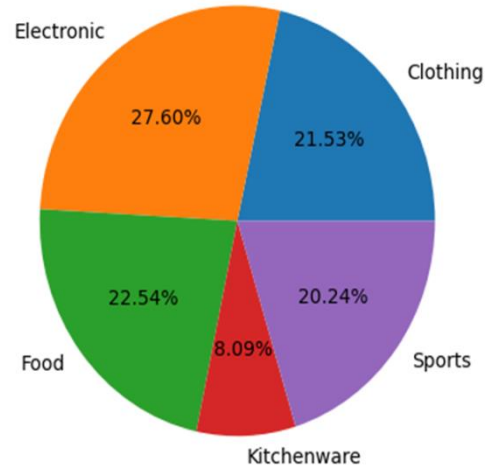
The result indicates the indexed values for product price range against the age of customers who visit the mall. This enables us to categorize the spending capacity of customers at specific age group to provide promotions and offers according to the predicted centroid values which ideally indicate their spending capacity.



Bar Graph for Ranges of Age Groups

The age group(s) having the higher concentration among the visited customers.

Number of Product Category purchased from the Mall



The graphical visualization can be customized to obtain data about the customer purchase behavior towards the products. The customer affection

**QR Scan time: 0.25s – 1.2s**

**Scan accuracy: ~ 95%**

**Prediction and Visualization accuracy: ~76.7%**

**Error margin in plotting: +5% to -5%**

## V. CONCLUSION

This paper will benefit shopping malls and businesses to adopt new technology and increase the consumer traffic. It is a cost-effective solution to medium-sized business as compared to the individual hosted solution. This application establishes that the use of QR code in shopping malls can greatly influence fast and efficient shopping analysis using numerous patterns of purchase and behavior of customers.

This enables the owners to access real-time information about their customer product purchase statistics by simply scanning for their required QR code. Importantly, the system will enable accurate statistical and graphical data reports and reliable data mining for the shopping mall on both consumer and

product information in a organized format by the use of QR code technology.

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## VII. REFERENCES

- [1]. H. Lu, X. Cao, and C. S. Jensen, "A foundation for efficient indoor distance-aware query processing," in 2012 IEEE 28th International Conference on Data Engineering (ICDE). IEEE, 2012, pp. 438–449
- [2]. Y.-M. Li, L.-F. Lin, and C.-C. Ho, "A social route recommender mechanism for store shopping support," *Decision Support Systems*, vol. 94, pp. 97–108, 2017.
- [3]. Department of CSE, Institute of Road and Transport Technology. *Asian Journal of Applied Science and Technology (AJAST)* Volume 1, Issue 4, Pages 37-39, May 2017.
- [4]. RajGopal, *Journal of Accounting and Economics*, 51, 1-20. Deepika Jhamb, Chitkara University and Ravi Kiran, Thapper Unniversity in *Journal of Emerging Knowledge on Emerging Markets*, November 2011.
- [5]. Prokopis k. Theodoridis and Anastasios p. panopoulos, *Hopping Centre image attributes effects on consumer's satisfaction and loyalty in Greece – Evidence at the initial stages of the economic crisis*
- [6]. International Standard ISO/IEC 18004 (2000). *Automatic Identification and data capture techniques-Bar code symbology-QR Code*, Switzerland.
- [7]. Constantinides, E., (2004), "Influencing the Online consumer's behavior: The web experiences", *Internet Research*, vol.14, no.2, pp.111-126.
- [8]. Lei Fu, *Design of QR Codebased, Mall Shopping Guide System*, International Conference on Information Science and Technology, March 26-28, 2011 Nanjing, Jiangsu, China.