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User conventional root detection of indoor mall

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ABSTRACT

Indoor navigation systems help people navigate inside large buildings such as shopping malls. In this paper, a smart location-based mobile shopping application for Android devices is proposed. The flow of the application is that user searches a product, and then INOP (Indoor Navigation and Online Payment) identifies the location and searches the product inside the shopping mall. To make the navigation system, this paper proposes a Shortest Path Algorithm. To add a product to the cart, the user should scan the barcode of the product with their android phone. Once the shopping is done by the user, the user can make payment online.

Keywords—*Indoor navigation, Barcode scanner, Wi-Fi router*

1. INTRODUCTION

Shopping Malls can be viewed as a single unit on Google Map, but it doesn't navigate inside the mall. This is the reason why usually customer in a Shopping Mall can't locate the required location of the product. Therefore, the customer keeps wondering in the Mall for the required product.

For Navigation GPS navigator is used worldwide. But GPS navigator has some limitations (like it can't work efficiently under the roof or inside a building). As the mall is in-door customer can't use GPS navigator as indoor navigation. And also, for searching for a required product is a tedious and time-consuming job and after shopping, the customer has to wait in a long queue at the cash counter. This makes customer frustrate and also consumes a lot of time and energy. To reduce the time for searching the required product and also for reducing the time for waiting in a queue.

In order to develop an Android Application that can navigate and uses a QR-Code scanner for the purchasing an item from the store that will be self-scanning and online payment transaction. Here come the term indoor navigation and QR-Code scanning. Indoor positioning is still a challenging problem because the satellite-based approach doesn't work indoors.

This paper introduces INOP (Indoor Navigation and Online Payment) application which can be used for navigation inside the mall. Also, the customer can scan the QR-Code of the product using a mobile. The essential details are displayed on the screen of mobile and customer can add to the cart. The cart product details are sent to the server and bill is generated by the system. This bill is sent to the customer's mobile through the system and using online banking service thus the user can make quick payment and leave the shop as soon as possible.

For Indoor Navigation the INOP application uses the Dijkstra's Algorithm. It's used for finding the Shortest Path for the customer from the current location to the destination location where the required product is there. The customer has to enter the current location and destination location as they enter in the Google Map and the directions will be displayed on the screen of the android mobile. When the Customer wants to buy that product he/she has to scan the QR-Code of the product using a mobile phone. The Scanned product will be added to the bill. Whenever the customer shopping will be over him /her can check out and make payment online on their phone.

The customer can also create a list in INOP application. This list consists of the products which customer wants to buy in Shopping Mall. This makes easy for the customer to search the product as listed. Then the bought product should be marked in the list.

2. EASE OF USE

2.1. Easy to find the location of the required Product

The customer doesn't need to find a location by him /her. In INOP application customer has to enter the current location and the destination location (required product location). Then the direction will be displayed on the screen of the customer's mobile. Customer needs to follow the direction to reach to the destination.

2.2 Easy to pay the bill.

The customer doesn't need to stand in a queue for paying the bill. Instead, the customer can pay the bill with their own

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device (android mobile). Customer needs to scan QR-Code of the product if he/she wants to buy and the product is added to the cart. When the customer checks out the bill is generated by the server and is sent to the customer's device (android mobile). The customer can pay the bill with various method (like online banking, credit card, debit card and also another method). If the customer doesn't have any account then they can simply pay the bill on the counter.

2.3 Simple and reliable

The process of searching the location, adding the product into the cart by scanning and paying the bill is simple for the common customer. Solve the problem with a solution set even for large data sets of information.

3. RELATED WORKS

Indoor positioning systems are specifically designed to assist users to navigate in the internal environment. These systems use the Wi-Fi signal and Dijkstra's Algorithm to assist in the movement proceeds. When Customer enters the current and destination location, then the direction is displayed on the customer device.

Customer adds the product to the cart by scanning QR-Code of the product. Then mark the bought product in the list. The Customer can check out after completing the shopping. Then the bill is generated by the server with the help of cart details. This bill is sent to the customer device (mobile) and he/she can make payment online.

In [1], Gennady Berkovich developed an Accurate and reliable real-time indoor positioning on commercial smartphones. This paper outlines the software navigation engine that was developed by SPIRIT Navigation for indoor positioning on commercial smartphones. First, the navigation engine can automatically start in any place of a building wherever user switches on his or her smartphone. There is no need to enter initial position manually or to start outdoors where initial position can be determined by GPS/GNSS receiver. Then, operating in the tracking mode, the navigation engine provides real-time indoor navigation for displaying current user position either on the floor plan or on Google Indoor Map if the latter is available for the building. At last, the navigation engine can recover tracking from failures that are the known problem of the particle filter occurring when all particles are accidentally discarded.

In [3], Suk-Hoon Jung, Gunwoo Lee, and Dongsoo Han developed a Methods and Tools to Construct a Global Indoor Positioning System. This paper aims to collect indoor and radio maps from volunteers who are interested in deploying indoor positioning systems for their buildings. The methods and tools for the volunteers are also described in the process of developing an indoor positioning system within the larger GIPS (Global Indoor Positioning System). An experimental GIPS, named KAIST indoor locating system (KAILOS), was developed integrating the methods and tools. The drawback is this system is in its initial state and need to solve lots of issues about navigation.

In [4], Payam Nazemzadeh, Daniele Fontanelli, David Macii, and Luigi Palopoli developed an Indoor positioning of wheeled devices for Ambient Assisted Living. The position tracking technique presented in this paper is based on an Extended Kalman Filter (EKF) and is analyzed through simulations in view of minimizing the number of sensors and devices in the environment. The drawback is that EKF is noise sensitive algorithm, simple changes in data could crash the application.

In [5], Siti Fatimah Abdul Razak, Choon Lin Liew, Chin Poo Lee, and Kian Ming Lim developed an Interactive android-based indoor parking lot vehicle locator using QR-code. This application is able to show the route from user current location to his parked vehicle based on an indoor map of the parking area stored in a database. In addition, it is also able to automatically detect the user's current movement based on steps calculation. The drawback is that this system needs to generate a different map for every different mall.

In [6], Da Su, Zhenhui Situ, and Ivan Wang-Hei Ho developed a Mitigating the antenna orientation effect on indoor Wi-Fi positioning of mobile phones. This paper improved mapping algorithm based on k-nearest neighbors (K-NN) is introduced to tackle the orientation effect, and an orientation based fingerprint database is established through studying the received signal strength patterns in different directions to handle the large fluctuation caused by orientation smartphone. It requires a well-configured sensor smartphone.

4. METHODOLOGY

4.1 Assumptions and design

The customer has to login into INOP (Indoor Navigation and Online Payment) application (if registered), else register first before login. The best-selling products and offers are displayed after customer login. The application also provides a recommendation to the customer according to his/her searched history. The customer can create a list which consists of products which he/she wants to buy. The customer enters the required product name in the search bar and it is checked into the database if available. Then the location of the product is sent to the customer by the server. If the product is not available then the message "Not in-stock" is displayed. The customer can add the product to the cart by scanning the QR-Code using his/her mobile. The essential details (like the price of the product, manufacturing date) is retrieved from the database and displayed on the mobile screen of the customer. The cart details are saved in the database. Whenever the shopping is over the customer can check-out, the bill is sent to the customer by the server which is generated by the server itself. Then the customer can pay the bill through online methods.

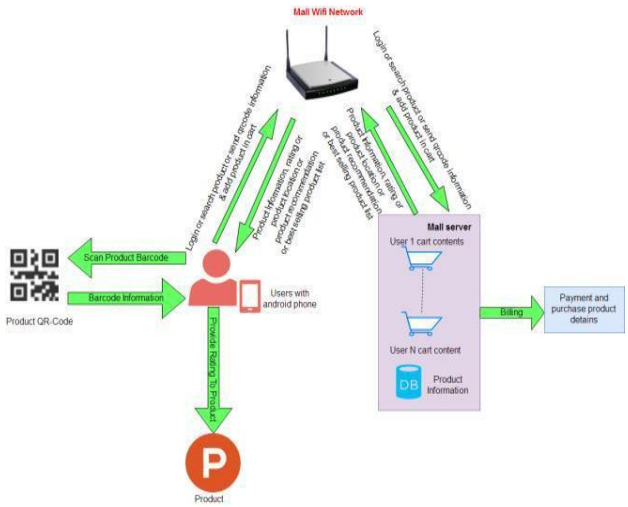

Fig. 1: Scenario of adding the Product into the cart

4.2 Proposed technique

The proposed technique uses (1) Shortest Path Algorithm (Dijkstra's Algorithm) to find the location of the product (2) The QR-Code Scanner for scanning the product and adding into the cart (3) Payment Predictor for paying the bill generated by the server.

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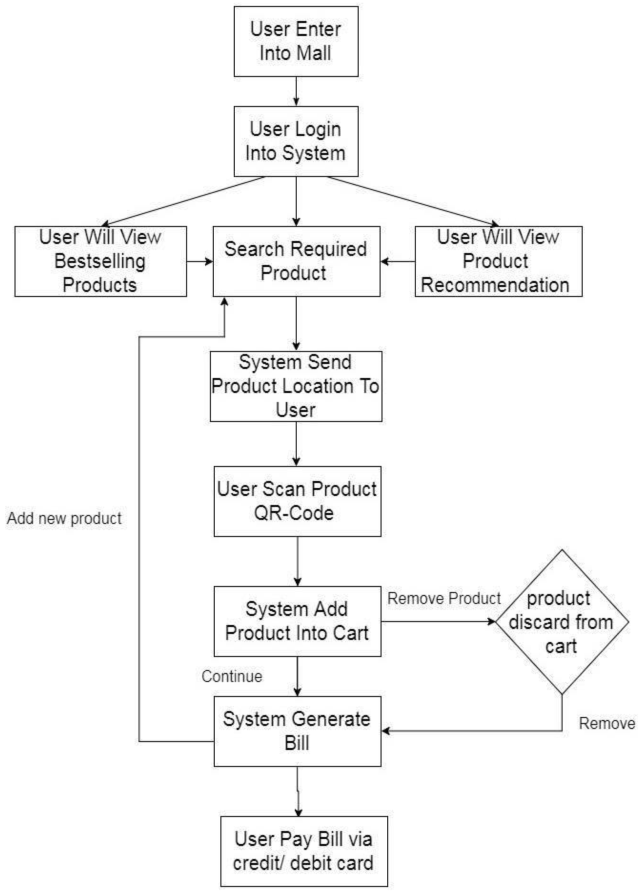

Fig. 2: Flowchart of the system

5. MATHEMATICAL MODEL

Let *S* be the whole system which consists:

$$S = \{IP, Pro, OP\} \quad (1)$$

Where,
IP: is the input of the system
Pro: is the procedure applied to the system to process the given input.
OP: is the output of the system.

5.1 Input

$$IP = \{Q, QRS, PR\} \quad (2)$$

Where,
Q: is a query
QRS: is QR-Code scanner
PR: User Provide Product Rating *B. Process*

5.2 Process

$$PRO = \{P, QS, U, SP, C, MS, RP, CB\} \quad (3)$$

Where,
P: is the set of product in the mall database
QS: a set of QR-Codes for each product P there exist QR-Code
U: User scan QS
SP: Set of Products for which QS scanned by User U
C: Shopping Cart for User U. Adds Set of Products SP in Cart C
MS: is Most Selling product list from product P
RP: is Recommended Product list from product P
CB: is Bill Calculating and Payment as per Set of Products SP.

5.3 Output

$$OP = \{PL, BA, C, VR\} \quad (4)$$

Where,
PL: Product Location.
BA: Bill Amount.
C: Purchase Product.
VR: View or Provide Rating to product.

5.4 Equations

5.4.1 Search product

$$RP == DB\ \Sigma^n i=1\ [pi] \quad (5)$$

Where,
RP: is a user required product
DB: is Data-Base
n: is the number of products
pi: is products from the database

5.4.2 *Recommendation Product*

The probability of Purchase Product PP

$$PP = ((\Sigma^n i=1\ (P+PS)) / (\Sigma^m i=1\ (P)) \quad (6)$$

Where,
PS: is user Selected Product
P: is targeted Product
n: Number of records in sales history where P and PS occurrences together
m: Number of records in sales history for occurrences of PS

6. ALGORITHMS

6.1 K-means

K-means is a simple and easy way to classify a given data set through a certain number of clusters (assume clusters). The main idea is to define k centers, one for each cluster. These centers should be placed in cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest center. When no point is pending, the first step is completed and an early group age is done. At this point we need to re-calculate k new centroids as barycenter of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new center. A loop has been generated. As a result of this loop, we may notice that the k centers change their location step by step until no more changes are done or in other words, centers do not move anymore.

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \| x_i^{(j)} - c_j \|^2 \quad (7)$$

Where, $||x_i^{(j)}-c_j||^2$ is a chosen distance measure between a data point $x_i^{(j)}$ and the cluster center c_j, is an indicator of the distance of the *n* data points from their respective cluster center.

K-Means Algorithm

Let X = {x1,x2,x3,……..,xn} be the set of data points and V = {v1,v2,…….,vc} be the set of centers.

1) Randomly select ‘c’ cluster centers.
2) Calculate the distance between each data point and cluster centers.
3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers.
4) Recalculate the new cluster center using:

$$v_i = (1/c_i)\sum_{j=1}^{c_i} x_i$$

Where ‘ci’ represents the number of data points in the i[th] cluster.

5) Recalculate the distance between each data point and new obtained cluster centers.
6) If no data point was reassigned then stop, otherwise repeat from step 3).

Fig. 3: K-Means Algorithm

6.2 Dijkstra's Algorithm

Dijkstra's Algorithm is used to find the shortest path from source to the destination location. When customer enters the shopping mall he/she needs to login into the INOP (Indoor Navigation and Online Payment) application and enter their current location and destination location (where the product is placed), the INOP (Indoor Navigation and Online Payment) application will direct the customer from current location to destination location (where the product is placed).

1) Assign to every node a tentative distance value: set it to zero for our initial node and to infinity for all other nodes.
2) Set the initial node as current. Mark all other nodes unvisited. Create a set of all the unvisited nodes called the unvisited set.
3) For the current node, consider all of its neighbors and calculate their tentative distances. Compare the newly calculated tentative distance to the currently assigned value and assign the smaller one. For example, if the current node A is marked with a distance of 6, and the edge connecting it with a neighbor B has length 2, then the distance to B (through A) will be 6 + 2 = 8. If B was previously marked with a distance greater than 8 then change it to 8. Otherwise, keep the current value.
4) When we are done considering all of the neighbors of the current node, mark the current node as visited and remove it from the unvisited set. A visited node will never be checked again.
5) If the destination node has been marked visited (when planning a route between two specific nodes) or if the smallest tentative distance among the nodes in the unvisited set is infinity (when planning a complete traversal; occurs when there is no connection between the initial node and remaining unvisited nodes), then stop. The algorithm has finished.
6) Otherwise, select the unvisited node that is marked with the smallest tentative distance, set it as the new "current node", and go back to step 3.

6.3 QR-Code

The Customer needs to scan QR-Code of the product which he/she wants to buy. The essential details (like price, manufacturing date, and expiry date) of the product will be displayed on the customer's mobile. Then he/she can add the product into the cart. The cart product details will be saved in the database for generating a bill.

6.4 Payment method

The generated bill by the server will be sent to the customer's mobile. Then the customer can pay the bill with the help of online payment method (like internet banking, credit card, debit card, and another method). In this paper, the online payment method is through credit card and all another payment method will be added in the future. The customer needs to fill details (like the name on the card, card number, and expiration date) of the credit card and proceed to checkout. If the customer doesn't have a credit card he/she can pay the bill on the counter.

7. CONCLUSION

The customer can use INOP (Indoor Navigation and Online Payment) application to make shopping easier. The time in searching the required product is reduced. The customer no longer has to wait at the counter for bill payment, he/she can directly pay a bill online.

8. ACKNOWLEDGMENTS

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