A Survey on the Internet of Things – Revolutionizing Relationships in the Shopping Centre

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ABSTRACT:: The Internet of Things (IoT) has evolved from just being an experimental concept, and is now completely transforming the ways in which industries operate. Forbes calls the Internet of Things a giant network of connected things, with relationships between people and people, people and things, and things and things. We consider the problem of tracking physical browsing by users in indoor spaces such as retail stores. Analogous to online browsing, where users choose to go to certain web pages, dwell on a subset of pages of interest to them, and click on links of interest while ignoring others, we can draw parallels in the physical setting, where a user might walk purposefully to a section of interest, dwell there for a while, gaze at specific items, and reach out for the ones that they wish to examine more closely. As our contribution, we design techniques to explore and track each of these elements of physical browsing using a combination of a smartphone shopping app which eases the customers' physical shopping experience and BLE beacons for indoor positioning. We believe that access to physical browsing information of shoppers in retail stores can not only provide crucial insights into shoppers' needs and interests but also reveal the effectiveness of the store layout itself..

KEYWORDS: Physical Analytics, Physical Browsing, BLE beacon, Smartphone app

I. INTRODUCTION

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

Web analytics is a multi-billion dollar business today, providing tools that measure and analyze users' online browsing behavior to help companies assess the effectiveness of their websites. A typical tool will track webpage-related events, such as page views, clicks, and the degree to which different landing pages are associated with online purchases.

Most purchases today, however, occur in the physical realm, e.g., at retail stores and shopping malls. While many retailers track shoppers' purchases (e.g.. as part of customer loyalty programs) in order to perform analytics, these system do not provide insight into shoppers' behavior during the shopping process, which we refer to as *physical browsing* in this paper. For example, which sections of the store did the shopper spend most of his or her time in? Which products did the shopper express interest in by gazing at them or reaching out for them? How many shoppers reached out for competing products A and B, say to compare these? We believe that access to physical browsing information of shoppers in retail stores can not only provide crucial insights into shoppers' needs and interests but also reveal the effectiveness of the store layout itself. Furthermore, such *physical analytics* that track in-store shopping behavior could also be combined with online information such as web browsing history or a shopping list to generate automatic alerts, say when there is a match between the physical browsing context and the online information.

The Internet of Things is transforming the Retail Industry. There is no doubt that retailers are excited about the possibilities IoT has to offer. However, when it comes to implementing IoT in their businesses, they are uncertain where to begin and the tangible value it can bring. In-Store shopping analytics and services, we adopt a vision of small data-based immersive retail analytics, where a mixture of sensor data, from personal wearable-devices and store-deployed sensors & IoT devices, is used to create real-time, individualized services for in-store shoppers. The main challenges are to use appropriate joint mining of sensor & wearable data to capture a shopper's product-level interactions, and the judicious triggering of power-hungry wearable sensors (e.g., camera) to capture only related portions of a shopper's in-store activities. The retail segment already uses IoT & "Big Data" to optimize store-level operations, such as predictive inventory management and merchandise layout planning. These innovations are, however, store-centric: they do not focus on using a shopper's in-store behavior to optimize or identify shopping-related facilities in real-time, while the user is inside the store. We believe that the joint real-time mining of sensor data, from store-deployed IoT devices and the personal mobile & wearable devices of an discrete shopper, can transform the in-store shopping experience. We present our work on the indoor positioning of users (shoppers), using a network of Bluetooth Low Energy (BLE) beacons deployed in a large wholesale shopping store. Our objective is to accurately determine which product sections a user is adjacent to while traversing the store, using RSSI readings from multiple beacons, measured asynchronously on a standard commercial mobile device. We further wish to leverage the store layout (which imposes natural constraints on the movement of users) and the physical configuration of the beacon network, to produce a robust and efficient solution. We introduce our node-graph model of user location, which is designed to represent the location layout. We also present our experimental work which includes an investigation of signal characteristics along and across aisles. We propose three methods of localization, using a "nearest-beacon" approach as a base-line; exponentially averaged weighted range estimates; and a particle-filter method based on the RSSI attenuation model and Gaussian-noise. Our results demonstrate that the particle filter method significantly out-performs the others. Scalability also makes this method ideal for applications run on mobile devices with more limited computational capabilities.

II. LITERATURE REVIEW

A future retail store should be able to address the following challenges: (i) Micro-activity recognition to identify shopper's interaction with individual items, (ii) BLE-beacon based fine-grained identification of the exact location from which the item was located/picked.

2.1 Summary & Discussion
Lee, S., Min, C., Yoo, C., and Song, J. Understanding customer malling behavior in an urban shopping mall using smartphones. real-time knowledge of a shopper's in-store activities and product-level interactions include: Smart Reminder that reminds you, for example, pick up milk only if you walk past the milk section without picking up milk; recipe Guru that identifies and provides alerts if you pick up the wrong item for your stated recipe; and Recommender that uses knowledge of the products you've been picking so far to build a dynamic, episode-specific interest profile, and suggest complementary items Reminders based purely on in-store location track on your smartphone, and recommendations based purely on general, longer-term customer profiles.

Y. Zeng, P. H. Pathak, C. Xu: fine-grained device motion recognition through Wi-Fi During a typical visit to a retail store, a shopper enters the store, purchases the intended products and leaves. This behavior can be further classified into fine-grained.

1. Each state of the shopper can be used to infer an activity related shopper's behavior. This map-ping between the states and the inferred. The tables also describe how the inferred activities are useful in analyzing various aspects of business strategies and feasibility of improvements.

R. Faragher, R. Harle, "An Analysis of the Accuracy of Bluetooth Low Energy for Indoor Positioning Applications", Our ongoing work which seeks to develop location-sensitive services to customers of a national chain of wholesale outlets (based in the UK). The project includes software components concerned with positioning, navigation, planning, and user experience.

Moller,̈ A., Diewald, S., Roalter, L., and Kranz, M. Mobimed: Comparing object identification techniques on smartphones. Proc. of NordiCHI'12. For a shopping study, we wanted to ensure that we could identify the picking action robustly. Picking action should be distinguishable from other similar actions or gestures such as putting items back/putting items aside, pushing/pulling a door etc.

III.   MOTIVATION

IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications.

We show in this work the indoor positioning and information of products to the customer with the help of using standard mobile app and an array of BLE beacons deployed in a wholesale store. The customer uses the shopping app which connects to the BLE beacons deployed at malls while shopping and facilitates the customer with all the product details on screen. This helps the customer in ease of shopping, better decision-making with all the product information on screen, time-saving and easy payment through app. As a case study, this is of interest to researchers and practitioners as it represents a commonly discussed use-case for indoor positioning (shopping), yet relatively little work has used live data from such environments using a BLE platform.

IV.   OBJECTIVE

Our project is concerned with enhancing the experience of users shopping at a wholesale store. The store is part of a national chain and users already have access to a mobile app which has been widely adopted by its customer. The objective is to add location-dependent services and data, including navigation information, which can be configured by the user depending on their requirements. We will experiment with a number of positioning systems, but the work we report here is concerned with determining the position in the store, using a network of BLE Beacons and a standard consumer mobile device. The objective of our system is to determine which aisle the user is in, and, as accurately as possible, their position along the aisle. This provides enough information to determine which products / product categories are adjacent to the user. Furthermore, we are primarily interested in determining which products are close to the user and display the information to the customer on screen. World of physical objects is extremely diverse. They have different communication, information and processing capabilities. Our objective is to study Internet of Things which is going to be an advanced network including normal physical objects together with computers and other advanced electronic appliances.

V.   PROPOSED WORK

We will demonstrate the use of IoT in retail stores mainly by using below tools and techniques:
Estimote BLE beacon: Bluetooth Low Energy (BLE) signals from battery driven beacons are at the core of the indoor location technology. It's one of the latest technologies that has emerged and become an industry standard available on most devices today. It uses so called BLE beacons (or iBeacons) that are inexpensive, small, have a long battery life and do not require an external energy source.

Smartphone: We will implement an android application which is used for shopping purpose, when customer installs application to its phone it will scan customer shopping information from a smartphone app and send request to BLE if particular information is available BLE shows information about specific items on smartphone application. If customer wants to purchase that item it will process further options like add to cart and redirect to payment page.
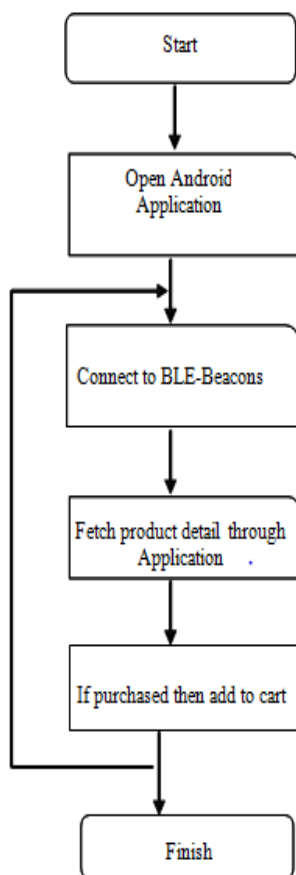

Figure: The proposed smartphone -BLE Beacon technique for in-store analytics

VI. CONCLUSION

In this paper, we present our work on indoor positioning of shoppers, using standard mobile hardware and an array of BLE beacons deployed in a wholesale store. The customer uses the shopping app which connects to the BLE beacons deployed at malls while shopping and facilitates the customer with all the product details on screen. This helps the customer in ease of shopping, better decision-making with all the product information on screen, time-saving and easy payment through app. As a case study, this is of interest to researchers and practitioners as it represents a commonly discussed use-case for indoor positioning (shopping). Working in harmony, these tools can drive decision-making across marketing; leasing and operations, helping management teams create the right tenant mix, inform staffing and security operations and create engaging events and promotions. The more information you gather the more you learn, the more you can act on, the better the experience.

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