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Where is my dinner? Using IoT and GPS to track my ordered fresh food

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Abstract

Home delivery service is an essential service for online shopping. The need for reliable delivery system to ensure freshness of foods is challenging with consumers' busy schedule and uncertainty in traffic. In this paper, we present a low-cost real-time GPS system that allows customers to schedule their food delivery more efficiently. Using this GPS system, consumers are able to track their delivery and arrival of their grocery products to ensure the freshness of products. Additionally, a user-friendly online grocery shopping system is presented for retailer to promote their grocery products and for customers to select their grocery in a more time-saving method. This website was developed to support the limited number of grocery online shopping websites in Hong Kong. To create the user-friendly access website, we incooperate four functions in this website: Online shopping cart, system support the new generation payment methods, GPS food tracking system, and members' easily access account data. This low-cost online system is designed to provide simple access for retailers (administrator, staff), customers, and visitor for creating a friendly online shopping standard.

Keywords: *Online shopping; Grocery shopping; Internet of things; GPS; Tracking Delivery*

1. Introduction

Continuous progress in technologies has led the development of new tools and programs for improving the quality of consumers' needs and satisfaction. With rapid evolving technologies, newer technologies (e.g., Internet of things, robots) and business models (e.g., member's subscription) emerged to embrace customers' consumption decisions [1]. With big data and predictive analytics, retailers can now offer better appealing offers, better target their customers, and develop better tools to encourage consumers to make purchase decisions. Meanwhile, consumers are receiving more beneficial offers to enable them to make more informed decisions [2].

Many factors that affect consumers' purchase decision. One concept, known as the "holistic customer experience" indicated that customer's cognitive, affective, emotional, social, and physical responses to the retailer is the success of a retailer among its competitors [3]. With technologies, retailers are progressing to meet the evolving consumer behaviors. These include using Internet of Things, virtual or augmented reality, robots, and artificial intelligence [4-5]. For instances, fashion retailer use augmented reality to help customers engage in virtual fashion show [4]. These technologies are used to help consumers to make good decisions, and increase their satisfaction to purchase.

Online shopping has been shown to provide more satisfaction to consumers who seek for convenience and speed [6]. It is convenience because it opens 24 hours per day, and 7 days per week. Consumers are able to access the online shop at their convenient time as long as they can access the Internet. Although the customers rarely have a chance to touch and feel the product, they are able to get product information from website and products' reviews by other customers before making their purchase decision. This gives customers more chances to compare price from different websites and find the product with a lower price than buying from local retailing stores. It also save time as customers do not have to stuck in the traffic, look for a parking spot, wait in checkout lines or be in crowd in store [7]. Meanwhile, there are some factors that impede consumers from online shopping, such as unsecured payment, slow shipping, intangibility of online product, competition with branded products, and lack of social contact [8-11]. Hence, retailer should continue to improve or create effective online shopping tools that could ease the customers concerns to persuade customer to use their online shopping system [12].

A user-friendly website is a main key to attract customers [13], especially for online stores with useful information of product, good customer service, and easy-to-access website [14]. Online shopping has progressed at an astonishing rate with total sales of 1.67 trillion US dollars in 2015 and is predicted to grow to 3.55 trillion US dollars by 2019 [15]. Such industry is flourishing throughout Asia region. The China's website, Alibaba, has a market capitalization of over US$535 billion [16]. In Hong Kong, online shopping is common amongst the highly educated (51% post-secondary educated) and the young and middle aged adults (e.g., 35% of people aged 35-44 shop online, but only 4% aged 55 and above shop online). For these online shoppers, median spending is HK$3,600 per year and average spending is HK$15,250 [17]. When asked what initially attracted them to shop online, 36% of consumers responded as being "quick and convenient" and 30% of consumers responded as online shopping is "cheaper than on-street", and 9% of respondents replied "lack of time to shop on-street/variety of product." Overall, 98% of these shoppers were satisfied of their online shopping experiences. In terms of shopping products, "non-branded clothes" is the most commonly purchased items by 89% of online shoppers, followed by "books/toys." It is surprising that these shoppers were not shop for

"household appliances" and "household grocery." A possible reason for low percentage online shoppers in this sector is customers are concerned about the delivery of grocery, especially for fresh food and vegetables, which have to be kept in good condition during delivery. Hence, an online grocery shopping system was developed and presented in this paper. Our system not only has user-friendly interface for online shopping, but also has a real-time GPS tracking system for goods delivery.

2. Our Proposed IoT Online Shopping System: *HKMall*

2.1. Project Scope

The *HKMall* online shopping system is designed for 4 main users: Administrator, Staff, Member and Visitor. The administrators have the full access to the system. The staff can manage the foods information and assist customers to handle their requests or questions. The visitors/members can browse the website and make their purchase decision. Figure 1 shows the system overview.

Fig. 1: System overview

Our online shopping system has 4 parts:

- Online shopping cart – Members add their favorite items to the shopping cart system for purchase.
- Support new generation of payment methods – When members making purchases on our online shopping system in Safari on their iPhone, iPad, or Mac, they can use Apple Pay without having to create an account or fill out lengthy forms. Additionally, with Touch ID on MacBook Pro, making payment transaction is quicker, easier, and more secure with this system.
- Track Arrival for ordered goods by GPS – When the order was paid, members can go to the 'Personal' page to review the purchase progress. We also provide GPS tracking system to track the real-time location of the ordered goods to make sure the goods can be delivered within a reasonable time to ensure the freshness of goods.
- Ease of accessing user data – Members can access their data easily. These data include their purchase histories and account information.

2.2. Functions of online shopping system

Our online shopping system provides different functions for different types of users. Figure 2 shows the sitemap of our online shopping website. The functions for each user type are shown in Figure 3a-d.

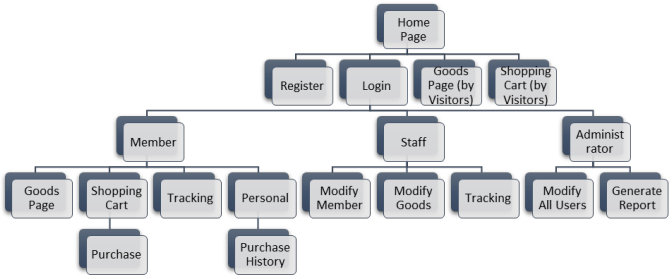

Fig. 2: Sitemap of our online shopping system.

Fig. 3a: Functions of an administrator

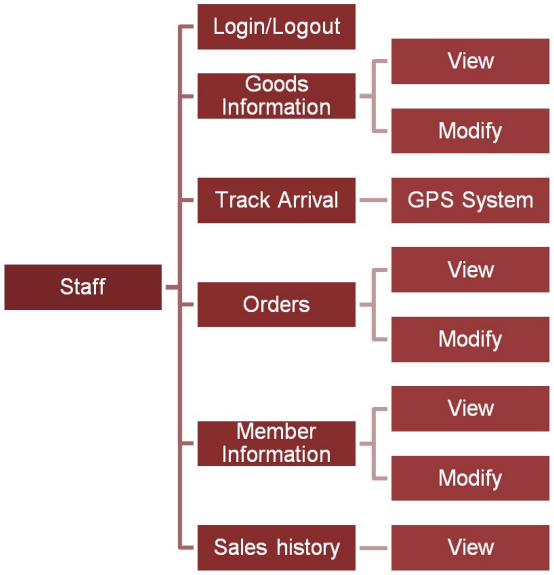

Fig. 3b: Functions of a staff

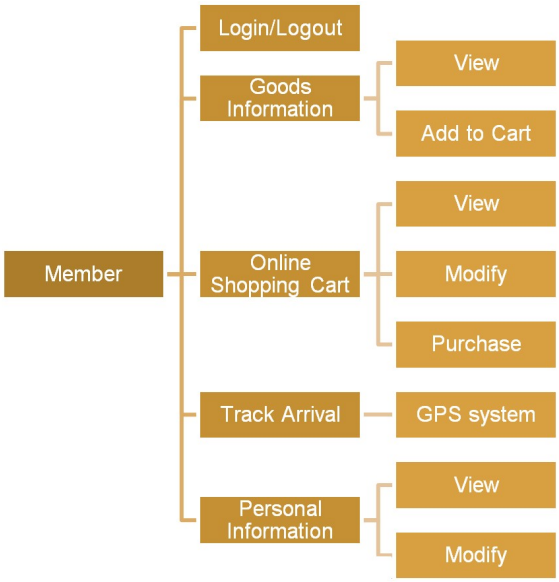

Fig. 3c: Functions of a member

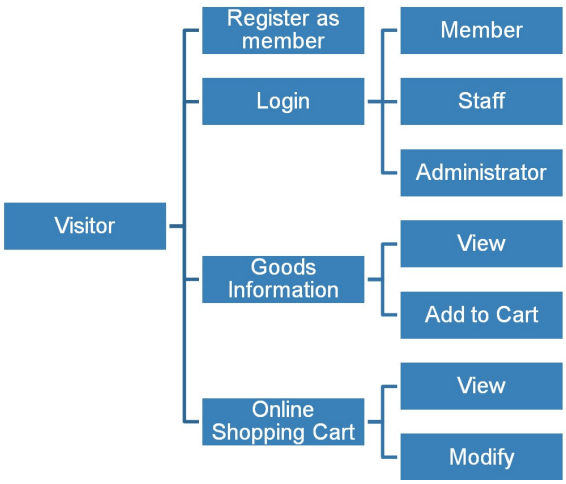

Fig. 3d: Functions of a visitor

3. System Design

3.1. Website

The front page of the *HKMall* online shopping system is shown in Figure 4a. The administrator could post news and offers on the middle of the webpage to attract customers. Visitors can login or register as member from the button on right top corner. Only members can make purchases in our online shopping system.

There are three categories of food selection on this website: Vegetabless & Fruits, Sweet & Snack, Meat & Seafood (Figure 4b). Customer could insert their preferable items (keyword) on the "search" button. Product desription is provided once the user click on the picture of the targeted product. Once an item has been selected, consumer can click "Add to cart" to confirm their purchase. For payment, consumer needs to input their credit card information (Figure 4c). Members can choose Apple Pay as the payment method as long as they use Safari to open the website. After the member click on "Confirm", the order form will be generated for consumer to print out. Consumer also can click "See purchase records" to check the purchase record.

After the order was shipped, the GPS function will start at the same time and customers can click the "More Details" (Figure 4d). The consumer can track the location of their product by clicking on the "Click me to check real-time tracking" (Figure 4e). The location will be updated automatically every 5 minutes (Figure 4f).

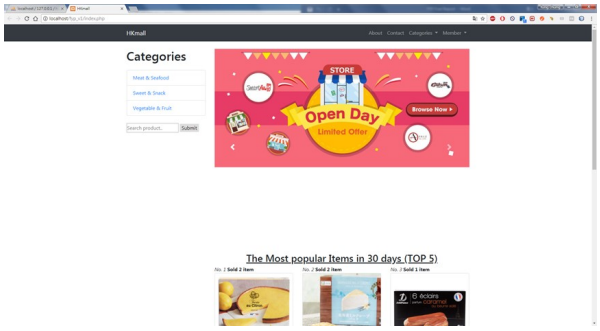

Fig. 4a: HKMall front page

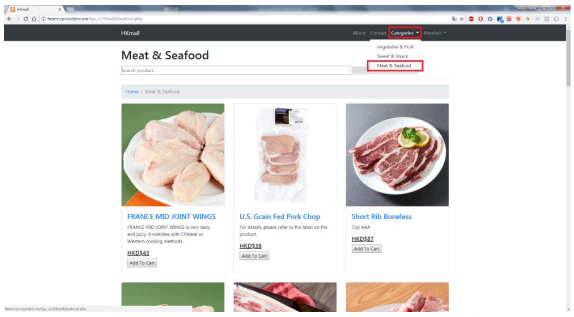

Fig. 4b: Features of the food categories

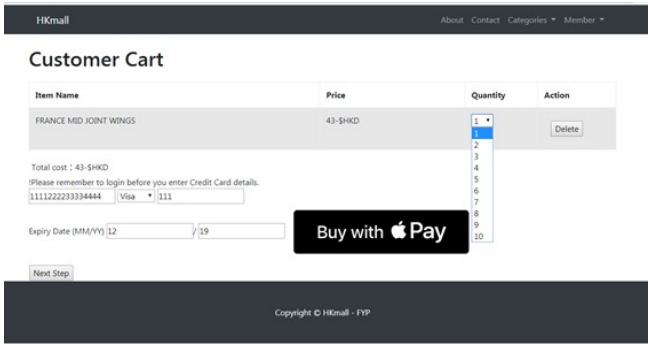

Fig. 4c: Payment page

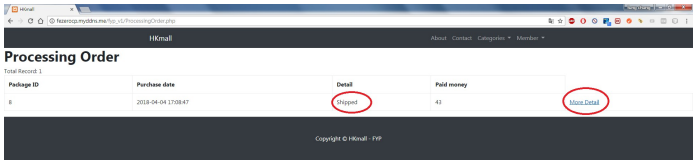

Fig. 4d: Checking on shipment

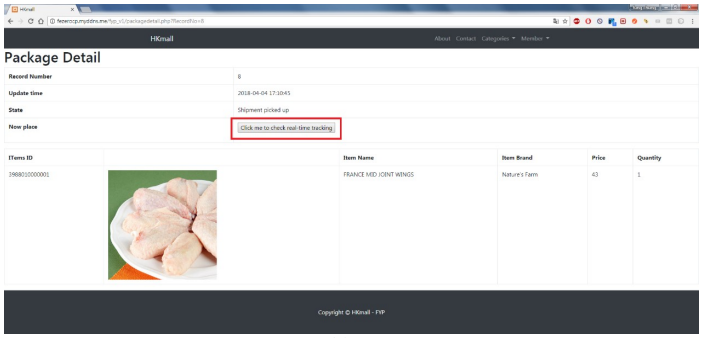

Fig. 4e: Tracking system

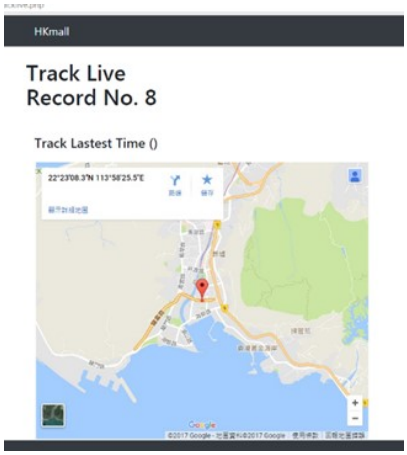

Fig. 4f: Real-time GPS tracking system

Meanwhile, the staff is able to manage the goods and orders on the webpage by selecting "Staff"→"Track Control" to visit the "Track List" page to manage the orders (Figure 5a and 5b). This function allows the staff to modify the status of the orders (e.g. processing, warehouse, with delivery courier etc.) and "UserShop Details" (shipped or arrived) (see Figure 5c).

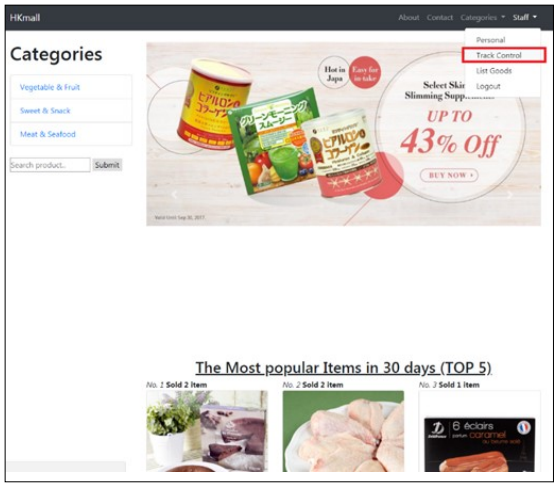

Fig. 5a: *HKMall* front page after staff login

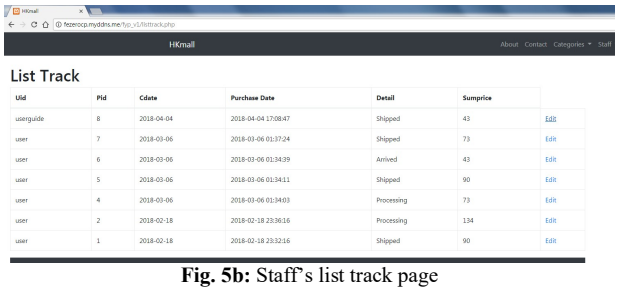

Fig. 5b: Staff's list track page

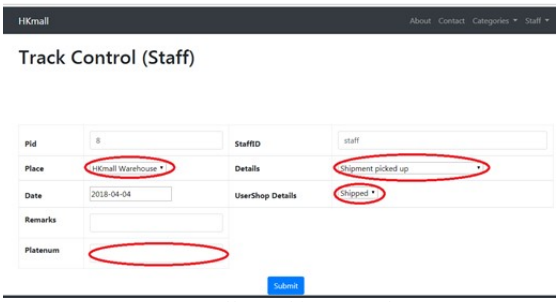

Fig. 5c: Staff's tracking control page

For administrator, the *HKMall* system allows the administrator to manage the staff information and customers' orders (Figure 6a). Meanwhile, administrator could manage the goods information by clicking on "List Goods" (Figure 6b). A report can be generated to check the items stocks in the warehouse (Figure 6c).

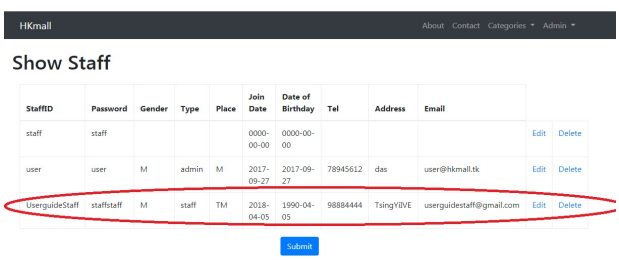

Fig. 6a: Administrator's page

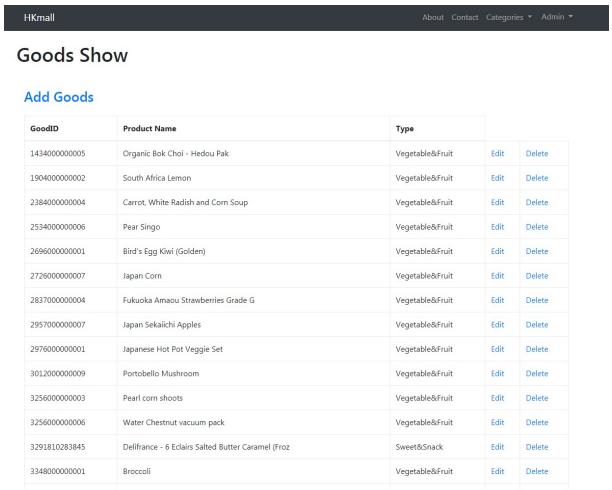

Fig. 6b: Goods page

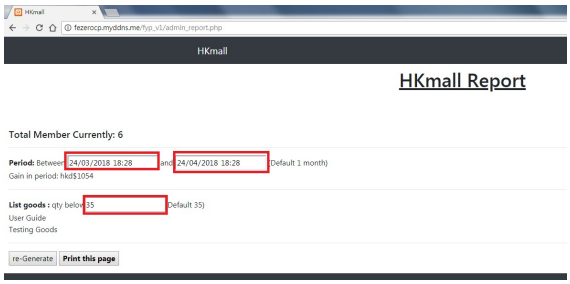

Fig. 6c: Report page for administrator

3.2. GPS Tracking System

Figure 7 shows the GPS structure of the *HKMall* system. QUECTEL MC20 is the core of our GPS system. It provides GPS service to obtain real-time location via mobile network signal. When the location data (i.e., latitude and longitude) was obtained and integrated, data will feedback to the QUECTEL MC20. Then, QUECTEL MC20 will send HTTP to get the request via TCP/IP. Finally, the data will be sent to Web server and uploaded to our database. An illustrative example is shown in Figure 8.

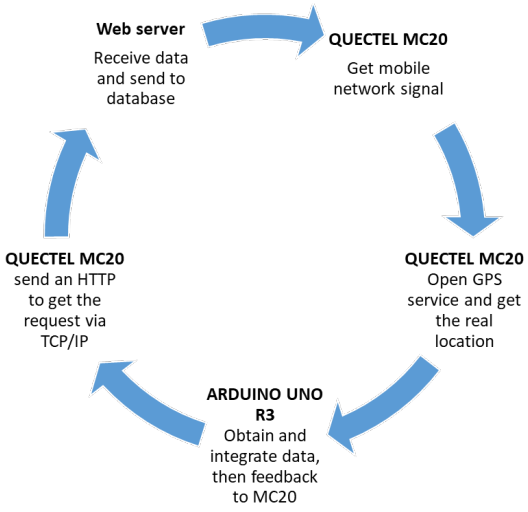

Fig. 7: GPS tracking system

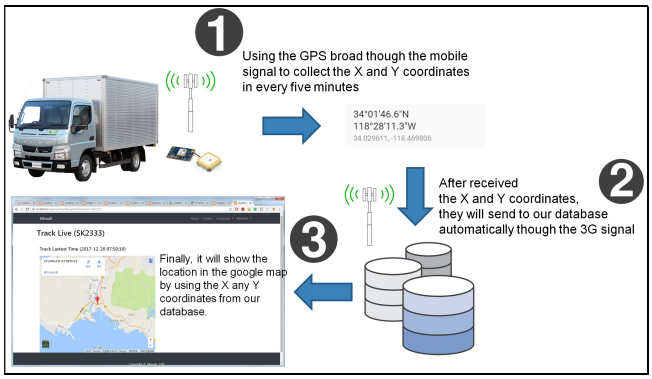

Fig. 8: An illustrative example for our GPS tracking system

4. System Requirements

4.1. Software requirements for developers

We use a number of software during our system development. They are:

- PHP – it is used for webpage design
- PHPMyAdmin – it is used for database administration
- NetBeans – it is used for web development tool
- Arduino IDE – it is used to develop our tracking system (as shown in Figure 9).

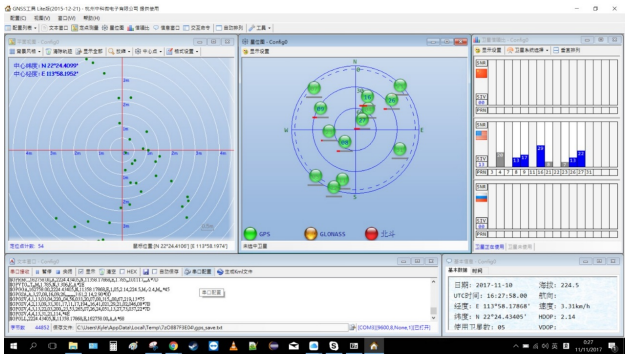

Fig. 9: Coding for tracking system in Arduino IDE

4.2. Hardware requirements for developers

We used low-cost hardware software for our system development. They are:

- **QUECTEL MC20 sensor** (Figure 10) – It is a high-performance GPS positioning module and it's in tiny size. It works with AT command and includes Bluetooth 3.0 to support SIM and USIM card.
- **ARDUINO UNO R3 motherboard** (Figure 11) – A microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

Fig. 10: QUECTEL MC 20 sensor

Fig. 11: ARDUINO UNO R3 motherboard

4.3. Software and hardware requirements for users

For our *HKMall* online shopping website, we recommended to use the Microsoft Windows 7 or latest operating system because technical assistance for Microsoft Windows XP is no longer available. Therefore, it is not secure for our website as it is at risk for virus infection and security issues. This website is developed with Google Chrome to ensure that users can visit our website and use the functions of the system easily. As mentioned before, Safari is needed for Apple Pay users. As long as connecting to the Internet, users can open our online system to purchase their items and track the real-time delivery status.

5. Conclusion

This paper presents the design of a *HKMall* grocery shopping website that consists of a series of fresh grocery goods for customers and a GPS real-time delivery method. The website can be access by consumer, retailer's staffs, and retailer's administrative for management purpose. This system provides a platform for retailer to promote the grocery products and customers to select their grocery in a more time-saving method. Consumers are able to track the delivery and arrival of their grocery products to ensure the freshness of products. Additionally, the GPS system allows the consumers to manage their schedule more efficient as they do not need to stay at home to wait for the package arrival after ordering their goods. This paper presents a low cost hardware system that use to track delivery that has potential to be used commercially by retailers.

References

[1] Grewal D, Roggeveen AL & Nordfält, J (2017), The Future of Retailing. *Journal of Retailing* 93, 1-6.

[2] Inman JJ & Nikolova H (2017), Shopper-Facing Retail Technology: A Retailer Adoption Decision Framework Incorporating Shopper Attitudes and Privacy Concerns. *Journal of Retailing* 93, 7-28.

[3] Verhoef PC, Lemon KN, Parasuraman A, Roggeveen A, Tsiros M & Schlesinger LA (2009), Customer Experience Creation: Determinants, Dynamics and Management Strategies. *Journal of Retailing* 85, 31-41.

[4] Deloitte (2016), *Retail Trends in 2016*, (accessed October 11, 2018), https://www2.deloitte.com/qa/en/pages/consumer-business/articles/retail-trends-2016.html

[5] Salman A, Abdullah MYH, Aziz J, Ahmad AL & Kee CP (2013), Utilising information and communication technologies (ICT) for development: What research contributes. *Journal of Asian Pacific Communication 23*, 239-251.

[6] Yu T & Wu G (2007), Determinants of internet shopping behaviour: an application of reasoned behaviour theory. *International Journal of Management 24*, 744-762.
[7] Childers TL, Carr CL, Peck J & Carson S (2001), Hedonic and utilitarian motivations for online retail shopping behavior. *Journal of Retailing* 77, 511-535.
[8] Abd. Mukti N (2017), Barriers to putting businesses on the internet in Malaysia. *The Electronic Journal of Information Systems in Developing Countries* 2, 1-6.
[9] Katawetawaraks C & Wang CL (2011), Online Shopper Behavior: Influences of Online Shopping Decision. *Asian Journal of Business Research* 1, 66-74.
[10] Shah Alam S & Mohd. Yasin N (2010), The antecedents of online brand trust: Malaysian evidence, *Journal of Business Economics and Management* 11, 210-226.
[11] Omar NA, Shah Alam S, Abdul Aziz N & Nazri MA (2011), Retail Loyalty Programs in Malaysia: The Relationship of Equity, Value, Satisfaction, Trust, and Loyalty among Cardholders, *Journal of Business Economics and Management* 12, 332-352.
[12] Shah MH, Peikari HR & Mohd. Yasin N (2014), The determinants of individuals' perceived e-security: Evidence from Malaysia. *International Journal of Information Management* 34, 48-57.
[13] Lim H & Dubinsky AJ (2004), Consumers' perceptions of e-shopping characteristics: an expectancy-value approach. *Journal of Services Marketing* 18, 500-513.
[14] Laudon KC & Traver CG (2009), *E-Commerce: Business, Technology, Society*, 5th edition, Prentice Hall, New Jersey.
[15] Statistica (2016), E-Commerce. Available online: https://www.statista.com/markets/413/ecommerce/U.S., last visit:23.10.2018.
[16] Statistica (2018), Market capitalization of the largest U.S. internet companies as of June 2018 (in billion U.S. dollars). Available online: https://www.statista.com/statistics/209331/largest-us-internet-companies-by-market-cap/, last visit:23.10.2018.
[17] Consumer Council (2016), Online retail: a study on Hong Kong consumer attitudes, business practices and legal protection. https://www.consumer.org.hk/sites/consumer/files/competition_issues/online-retail/full%20report_e.pdf, last visit:14.10.2018.