Journal of Engineering and Applied Sciences 13 (2): 415-421, 2018
ISSN: 1816-949X

Internet of Things (IoT): Architectural Framework for Secure Payment Mode

Ali Shawket Thiab, Abdul Samad Bin Shibghatullah and Zeratul Izzah Mohd. Yusoh
Faculty of Information and Communication Technology, Universiti Teknikal Malaysia,
Melaka, Malaysia

Abstract: This research shows the revolution in technology and technological inventions. It focuses on innovations such as the internet of things and how it can be integrated in e-Commerce to improve business operations. The explored aspects are the different types of e-Commerce businesses and how they have changed over time. The study also identifies the various security techniques in e-Commerce based on internet of things that can be used to improve the industry. The scope of this study is confined security model for e-Commerce based on internet of things.

Key words: e-Commerce, internet of things, security, business, revolution, technology

INTRODUCTION

The arrival of the Internet of Things (IoT) in the mid 90's did not only result into extensive and innovative research but also the upcoming of innovative ideas aimed at solving problems practically within the business context through the use of existing technology (Maney, 2015).

The internet of things gained popularity in 2010 and has recently attracted the attention of most scholars and business decision makers. The IoT is a linking factor for various elements such as buildings, cars, different equipment and people. The IoT also works on linking offline objects to the e-Commerce business models. A centralized IoT platform hosted by the firm's e-Commerce will be responsible for mining data into valuable information to be used for making decisions in the e-Commerce business. The e-Commerce system is integrated with the IoT technology in three different aspects such as; inventory, logistics and payment systems (Muhonen, 2015).

Security is one of the key issues affecting the IoT technology. The technique has implemented various mechanisms to ensure that all data and transactions done over the internet are secure from vulnerability. An unsecured IoT system can be vulnerable to potential cyber-attacks and data intrusion. It is important to keep security in mind while outlining the design considerations for an IoT system.

Individual privacy of users is an essential factor to consider. Therefore, strategies and mechanisms need to be implemented to enforce privacy of data and information for the user's operation over the IoT services (Lee and Lee, 2015).

The research offers an improved design system to be used in the e-Commerce based on internet of things. The new e-Commerce based on the IoT system will encompass the following elements: overview of the e-Commerce security and the different specific security issues in e-Commerce business. The security issue in e-Commerce lies in the e-Commerce asset protection which does not permit anything within the site to be altered or destroyed. However, the system does not guarantee the safety of the survivors within. Such security issues include; spamming, surfing, distributed denial of service attack, viruses, worms, trojan horses, illegal access, masquerading or spoofing, sniffers, operating system loopholes and theft of data (Laudon *et al*., 2007).

Literature review: The internet was first developed in 1960 from the US military network (ARPANET). It was created to link computers around the world with the anticipation that the interconnection would allow sharing and quick access of data and information around the world. The World Wide Web was also developed to create a more user friendly interface for the internet. It was invented by a British scientist, Tim-Berners Lee at the European Physics Laboratory (CERN). During this period, the internet used a GUI with web browsers like Netscape and Internet Explorer. Web browsers became available and free of charge in 1993 and it was called Mosaic which was the precursor of Netscape. The web allows connection of different web pages through the use of a hyperlink which creates link to other pages on the same website or different websites from a different computer (Lee and Lin, 2005).

Corresponding Author: Ali Shawket Thiab, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia, Melaka, Malaysia

The revolution of the internet technology has brought in improvements in the business industry. It has made applications to be easily accessible and available. Hence, the use of e-Commerce has become more predominant in the virtual community (Zhang and Xu, 2011).

e-Commerce: e-Commerce describes all the transactions that are done over the internet with the help of digital technology. Mostly, there is an exchange of money for goods or services across boundaries of the organization. A commercial exchange or trade only occurs if there is a value exchanged with a product or service (Han and Li, 2012; Terpstra *et al*., 2012; Presser *et al*., 2011).

There has been a debate on the limits of e-Commerce and e-Business and the difference between the two. While some argue that e-Commerce is a worldwide electronic based organization supporting activities in a firm market exchange infrastructure including the information system, others claim that e-Business covered both the internal and external electronic based activities inclusive of e-Commerce.

e-Commerce comprises of seven unique features as mentioned by Laudon *et al*. (2007): Ubiquity, global reach, universal standards richness, interactivity, information density and personalization/customization (Laudon *et al*., 2007; Lee and Lin, 2005; Zhang and Xu, 2011; Han and Li, 2012; Terpstra *et al*., 2012; Presser *et al*., 2011; Palfrey and Gasser, 2008; Dinev *et al*., 2015; Zmud *et al*., 2016; Shapiro and Varian, 1998; Goodman, 2015; Gubbia *et al*., 2013; Kingston, 2001; Najafi, 2014; Rayport and Jaworski, 2002; Kalakota and Robinson, 2003).

MATERIALS AND METHODS

Internet of things communication models

Device to device communications: The network devices in this set up rely on certain protocols for communication and exchange of messages across the platform. The model is mostly used in applications that use small data packets of information for communications such as home automation systems. The devices usually have a direct link with trust and security mechanisms (Fig. 1).

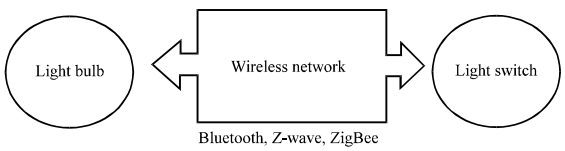

Fig. 1: Device to device communications (Tschofenig *et al*., 2015)

Device-cloud communications: The setup uses existing communication mechanisms like Ethernet and Wi-Fi connections to create links between devices and the IP network and finally connect to the cloud. The model is widely used in consumer devices such as thermostat nests and Samsung smart TV. The connection allows users to get remote access to the thermostat devices via their cell phones. The technology gives users the ability to expand the original features in the tool. The platform allows for the integration of devices connected hence guaranteeing security (Fig. 2).

Device to gateway model: The devices use a model of device application layer gateway (ALG). The devices access the cloud services through the ALG system with the use of an intermediate software system between the devices and the cloud service which provide security and data protocol translation services. The local gateway device is usually a mobile phone through which the application runs and communicates with devices and ease data delivery to cloud services (Fig. 3).

Back-end data sharing model: It allows users to export and analyze object data from smart cloud services and combine them with data from other sources. It provides access to sensor data uploaded to a third party. The effective architecture enables a company the access to the data generated from the spectrum of devices and also allows the analysis of this data by the company. It also facilitates the need and the use of mobile data and it allows users to effectively migrate their information when switching to the IoT. It helps in achieving the interoperability between backend systems (Fig. 4).

Fig. 2: Device-cloud communications (Tschofenig *et al*., 2015)

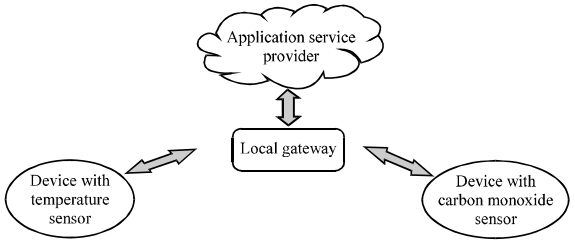

Fig. 3: Device to gateway model (Tschofenig *et al*., 2015)

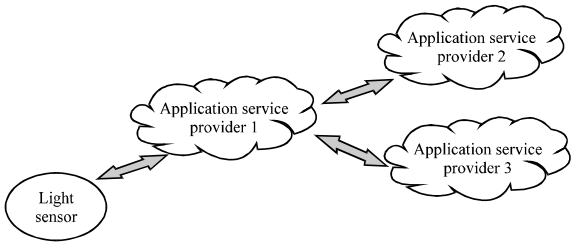

Fig. 4: Back-end data sharing model (Tschofenig *et al*., 2015)

RESULTS AND DISCUSSION

Framework for e-Commerce based on IoT: The architecture allows users to make use of the network resources in a cost effective format that replaces the traditional architectural model. Figure 5 describes an e-Commerce model based on the IoT framework.

The base layer links the system to other service providers. The IoT enables access to data through the means of secure and flexible hardware resources. The platform layer handles mass storage, parallel computing and data mining while the application layer handle commercial software used in the e-Commerce business (Palfrey and Gasser, 2008; Dinev *et al*., 2015; Zmud *et al*., 2016; Shapiro and Varian, 1999; Goodman, 2015).

Service provider: The service provider can either issue pure ICT services or be a supply chain partner that provides business services (B2B e-Commerce). Both service types of service providers have to be integrated on in-formation system level for seamless process execution. This study would like to demonstrate how all those services can support business layer of online retailer.

Figure 6 shows an application interface is specified as a point of access which is assigned to an application service to expose the service to its environment which could be a user or another application component. An application function describes the internal behavior of an application component. If this behavior is exposed externally, this is done through one or more services. An application function abstracts from the way it is implemented sonly the necessary behavior is specified (Dinev *et al*., 2015).

Platform provider: The pluggable service platform acts as an intermediary between the retailer and the service provider. The goal of the platform is twofold: it should allow retailers to source ICT services from third party providers instead of having all the needed functionalities served as native capabilities in web-shop and the platform should enable retailer to collaborate with supply chain partners.

Typically, this layer consists of middleware node representing a hub and spoke solution to allow communication between all other infrastructure nodes. The enterprise service bus is an example of such a middle ware implementation. This enables communication between applications without requiring from each of these applications to know the communication details of peer applications which in the end avoiding point-to-point system topology.

Figure 7 shows two key components in this layer are the collaborative service and process framework and collaborative data management. Derived from the findings in the collaborative service and pro-cess framework component encompasses:

- A service framework which borrows its functionality from SOA governance and API management, providing the meta-services to maintain services throughout their lifecycle
- A process framework to develop, execute, analyse and monitor service-based process flows

The collaborative data management component as the name suggest, provides a central repository of both master and transaction data which can be accessed by the E-tailer, its business partners and service providers to be used in distributed service-based business processes. This component exposes its functionalities as the master/ transaction data service. Master data can be viewed as nouns (business objects) while transaction data as verbs (action performed to the business objects).transaction data are often categorized into financial (involves orders, invoices, payments), work (plans and work records) and logistic data (deliveries, travel records, etc). Master/ transaction data service ensure consistent, unified view of data across all partners (Shapiro and Varian, 1999; Moodie *et al*., 2006; Evans and Wurster, 1997; Bakos, 1997; Kambil, 1997; Shim *et al*., 2013).

Figure 7 shows the collaborative data management component is realized by cloud-based database services, which are commonly referred to as Database-as-a-Service (DbaaS). One of the main benefits of cloud platforms lies in the centralized storage of resources. Having files or media content stored in a shared repository is beneficial for reuse throughout systems and collaboration among different par-ties. While the present cloud integration platforms shift existing integration middleware features to the cloud, they do not embrace this key benefit of having shared resources among systems and collaboration

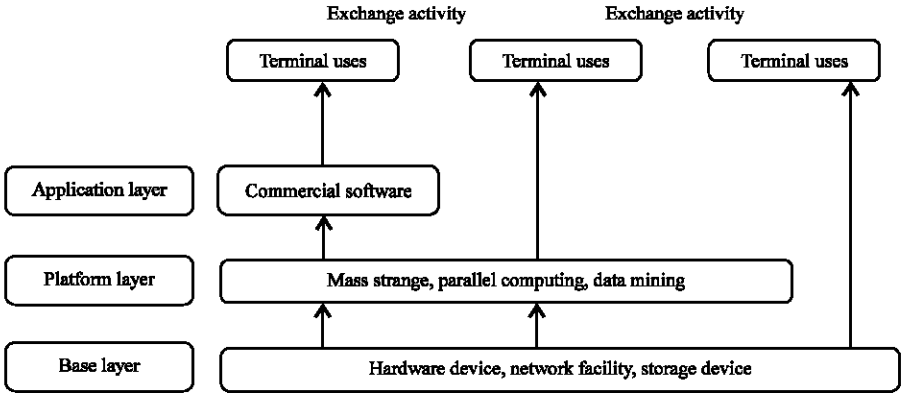

Fig. 5: IoT based e-Commerce system

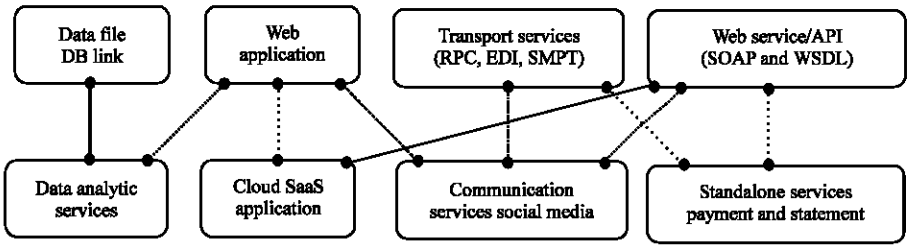

Fig. 6: Proposed architecture of service provider

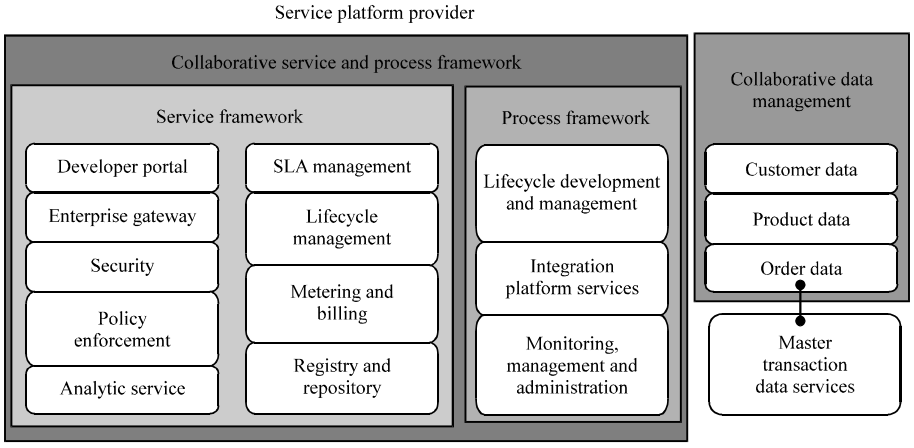

Fig. 7: Proposed architecture for platform provider

partners. The reason for this shortcoming lies in their generic nature and the platforms which fail to identify the resources. The domain specific platform architecture will therefore define the resources that are crucial throughout all transactions in a retailing process. Besides, DBaaS inherits pretty much the same benefits of outsourcing IT infrastructure to the cloud such as flexibility, scalability and lower investments (Sinha, 2000; Agag, 2016; Daniel, 2003; Resnick *et al*., 2006; Austin, 2009; Heinze, 2016; Costa, 2016).

Nevertheless, cloud database is perceived to be having security issues such as lack of privacy which can reduce trust of users. Data security in the cloud could be preserved by meeting security requirements such as data confidentiality, integrity and availability. Data confidentiality means that the data in the cloud can't be accessed by unauthorized party. One way to achieve this is to implement proper encryption mechanism. Data integrity means that the stored data is accurate and consistent throughout its lifecycle. Last, data availability

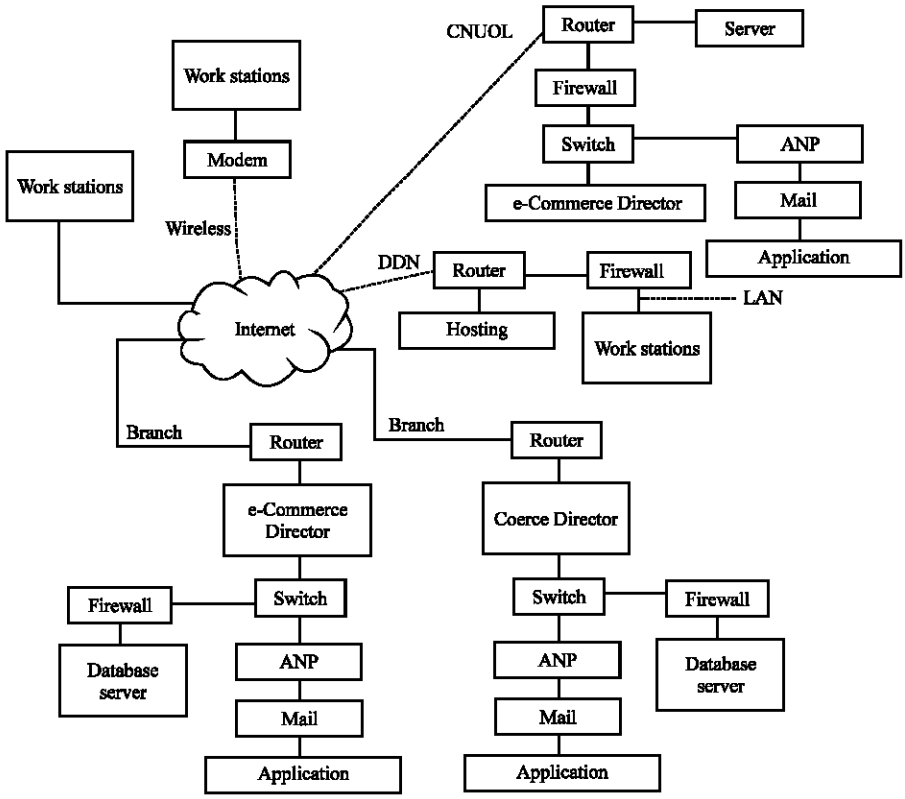

Fig. 8: IOT e-Commerce secure payment mode

ensures the stored data is available when requested by authorized users (Yang and Miao, 2005; Levina and Ross, 2003; Porter, 1985; Wortmann and Fluchter, 2015; Carvalho and Souza, 2015; Rose *et al*., 2015; Mulani and Pingle, 2016; Endo *et al*., 2012; Tschofenig *et al*., 2015; Shelkikar and Wagh, 2016).

Current problem: The common online electronic payment systems include the internet bank card payment system which enables users to pay for services online by using credit card payment systems. The system operates on four basic models namely, no security model, third party brokers paid model simple encrypted payment model and security electronic transaction model such as SET. This study will address specific problem on the use of debit and credit card online. Once a credit card has been used in an online transaction, it becomes vulnerable to be used or abused for another transaction due to anonymity issue. Another electronic payment system is the e-Cash internet payment system which is more efficient as it provides anonymity, saves on transaction and transmission costs and enhances flexibility. Other methods including the e-Purse and e-Check internet payment systems are also vulnerably subjected to the above problem.

Proposed model: The e-Commerce system consideration can be viewed in three different dimensions. The dynamic control used for system upgrade, the real time detection, response and recovery and security coordination between similar components (Lee and Lee, 2015). Figure 8 illustrates the working of an IoT e-Commerce secure payment mode. This new model will pay special attention to the new card number. This IoT card number will be dynamically changed and updated to the new number. Therefore, it will be a unique number per transaction which is recognized by the IoT service providers since it is digitally signed by the financial provider.

The proposed model is based on Pocket perceive (PC) is a personal mobile intelligent terminal of the e-Commerce businesses. Lightweight Tablet PC is used as a carrier with an embedded RFID reader payment module, smart card payment is perfect integration with online sales, it realizes a simple and secure payment application mode. IoT PDAs payment resolved program is that RFID reader module is combined with tablet PCs for the first time, the user does not need to pay by cumbersome online banking, there is just a portable handheld computers, the entire process is completely contactless (Fedyshin, 2016).

The IoT smart card payment is different payment with other online payment tool such as Alipay, Tenpay and this payment is the innovation applications of the latest IoT RFID contactless technology. Internet shopping is combined together with IoT payment, lightweight Tablet PC is used as a carrier, payment module is embedded in the RFID reader, simple and secure smart card payment application mode is achieved by technical means. In IoT handheld payment, all funds were allocated through a bank dedicated channel to avoid security risks through open Internet. By using the AES algorithm, all the data are encrypted for users on the card and on data transmission from mobile devices to clearing center, these ensure maximum safety of funds.

CONCLUSION

In this study, the development trend of IoT applications has been analyzed in e-Commerce, the problems are described in traditional e-Commerce. In the IoT technology application, there are three important aspects such as e-Commerce inventory, logistics and payment. This research studied the key technical issues of e-Commerce security measures.

The IoT technology applications are very broad in e-Commerce, its application methods and types are varied. IoT technology can be used in various aspects of e-Commerce, it has brought not only a new economic growth point in e-Commerce and a series of problems can be solved and the core competitiveness is enhanced significantly for e-Commerce. But it must be clearly recognized that the application of IoT technology is still at a relatively and early stage, the relevant technology is not mature. This requires current research focus on the long term, IoT technology and standards also are improved and elated. Only in this way, can make good use of this new IoT technologies, there is a huge impetus to the development of e-Commerce.

SUGGESTIONS

It is of great importance to attach the presence of network security, system stability, data protection and other issues. There are good alternatives, a good balance is grasped between development demand and technology management system, the order and healthy development is achieved in the IoT industry. The development of machine-to-machine IoT business is accelerated in electric power, logistics, manufacturing, security and other fields. The support system of IoT technology, service platforms and management platform are built and the operating environment is created to adapt to universal access IoT.

REFERENCES

Agag, G., 2016. A framework for B2C and B2B E-commerce ethics and its effect on customer satisfaction: A comparison study between the UK and Egypt. Ph.D Thesis, Plymouth University, Plymouth, England, UK.

Austin, G.W., 2009. Importing Kazaa: Exporting grokster. Santa Clara Comput. High Technol. Law J., 22: 577-620.

Bakos, J.Y., 1997. Reducing buyer search costs: Implications for electronic marketplaces. Manage. Sci., 43: 1676-1692.

Carvalho, T.D. and T.L. Souza, 2015. [Internet of things and its application in libraries(In Portuguese)]. Manage. Electron. J. Organizational Manage., 13: 264-270.

Costa, E.D., 2016. Global E-Commerce Strategies for Small Businesses. MIT Press, Cambridge, Massachusetts, USA., Pages: 198.

Daniel, E., 2003. An exploration of the inside-out model: E-commerce integration in UK SMEs. J. Small Bus. Enterp. Dev., 10: 233-249.

Dinev, T., A.R. McConnell and H.J. Smith, 2015. Research commentary-informing privacy research through information systems, psychology and behavioral economics: Thinking outside the APCO box. Inf. Syst. Res., 26: 639-655.

Endo, S., J. Yang and J. Park, 2012. The investigation on dimensions of E-satisfaction for online shoes retailing. J. Retailing Consum. Serv., 19: 398-405.

Evans, P.B. and T.S. Wurster, 1997. Strategy and the new economics of information. Harv. Bus. Rev., 75: 70-82.

Fedyshin, I.B., 2016. Electronic Business and Electronic Commerce (Supporting Lecture Notes for Students of Dir?ction Management of all Forms of Education). Ternopil State Medical University, Ternopil, Ukraine, Pages: 111.

Goodman, E.P., 2015. The Atomic Age of Data: Policies for the Internet of Things. Aspen Institute, Washington, DC., USA., ISBN: 0-89843-623-0, Pages: 67.

Gubbia, J., R. Buyya, S. Marusic and M. Palaniswami, 2013. Internet of things (IoT): A vision, architectural elements and future directions. Future Generat. Comput. Syst., 29: 1645-1660.

Han, J. and Z.P. Li, 2012. Constructing logistics e-commerce platform based on internet of things. Value Eng., 31: 10-14.

Heinze, J., 2016. New channels for old businesses: Examining the drivers and obstacles of mobile commerce adoption for complex products. Ph.D Thesis, University of Regensburg, Regensburg.

Kalakota, R. and M. Robinson, 2003. Services Blueprint: Roadmap for Execution. Addison-Wesley, Boston, Massachusetts, USA., ISBN:9780321150394, Pages: 354.

Kambil, A., 1997. Doing business in the wired world. Comput., 30: 56-61.

Kingston, R., 2001. The social implications of E-commerce: A review of policy and research. Master Thesis, Joseph Rowntree Foundation, York, England, UK.

Laudon, K.C., C.G. Traver and A.V.R. Elizondo, 2007. E-Commerce. Pearson, London, England, UK.

Lee, G.G. and H.F. Lin, 2005. Customer perceptions of e-service quality in online shopping. Int. J. Retail Distrib. Manage., 33: 161-176.

Lee, I. and K. Lee,q 2015. The Internet of Things (IoT): Applications, investments and challenges for enterprises. Bus. Horizons, 58: 431-440.

Levina, N. and J.W. Ross, 2003. From the vendor's perspective: Exploring the value proposition in information technology outsourcing. MIS. Q., 27: 331-364.

Maney, K., 2015. Meet Kevin Ashton, father of the internet of things. Newsweek Inc., New York, USA. http://www.newsweek.com/2015/03/06/meet-kevin-ashton-father-internet-things-308763.html.

Moodie, R., B. Swinburn, J. Richardson and B. Somaini, 2006. Childhood obesity-a sign of commercial success but a market failure. Pediatr. Obesity, 1: 133-138.

Muhonen, T., 2015. Standardization of industrial internet and IoT (IoT-Internet of Things): Perspective on condition-based maintenance. Master Thesis, University of Oulu, Oulu, Finland.

Mulani, T.T. and S.V. Pingle, 2016. Internet of things. Intl. Res. J. Multidiscip. Stud., 2: 1-4.

Najafi, I., 2014. Identify effective factors for improving E-trust of E-transactions in the context of E-commerce and E-government. Intl. J. Comput. Trends Technol., 17: 281-299.

Palfrey, J. and U. Gasser, 2008. Born Digital: Understanding the First Generation of Digital Natives. Basic Books, New York, ISBN-13: 9780465005154, Pages: 375.

Porter, M.E., 1985. Competitive Advantage: Creating and Sustaining Superior Performance. The Free Press, New York.

Presser, M., S. Krco, T. Kowatsch, W. Maass and S. Lange *et al*., 2011. Inspiring the internet of things: The internet of things comic book. MS Thesis, Alexandra Institute, Aarhus, Denmark.

Rayport, J.F. and B.J. Jaworski, 2002. Introduction to E-Commerce. McGraw-Hill, New York, USA., ISBN-13:978-0-07-286525-7, Pages: 512.

Resnick, P., R. Zeckhauser, J. Swanson and K. Lockwood, 2006. The value of reputation on eBay: A controlled experiment. Exp. Econ., 9: 79-101.

Rose, K., S. Eldridge and L. Chapin, 2015. The internet of things: An overview. Internet Soc., 1: 1-50.

Shapiro, C. and H.R. Varian, 1998. Information Rules: A Strategic Guide to the Network Economy. Harvard Business Publishing, Brighton, Boston, Massachusetts, USA., ISBN:0-87584-863-X, Pages: 357.

Shapiro, C. and H.R. Varian, 1999. The art of standards wars. California Manage. Rev., 41: 8-32.

Shelkikar, R.P. and N.S. Wagh, 2016. Review paper based on women tracking device using concept of internet of things. Intl. J. Appl. Innovation Eng. Manage., 5: 63-73.

Shim, J.K., A.A. Qureshi, J.G. Siegel and R.M. Siegel, 2013. The International Handbook of Electronic Commerce. Routledge, Abingdon, UK., ISBN:1-57958-260-5, Pages: 293.

Sinha, I., 2000. Cost transparency: The Net's real threat to prices and brands. Harv. Bus. Rev., 78: 43-49.

Terpstra, V., J. Foley and R. Sarathy, 2012. International Marketing. 10th Edn., Naper Publishing Group, Naperville, Illinois, ISBN-13:978-0981729350, Pages: 600.

Tschofenig, H., J. Arkko, D. Thaler and D. McPherson, 2015. Architectural considerations in smart object networking. Inf. RFC., 1: 1-24.

Wortmann, F. and K. Fluchter, 2015. Internet of things. Bus. Inf. Syst. Eng., 57: 221-224.

Yang, J. and G. Miao, 2005. The estimates and forecasts of worldwide E-commerce. Proceedings of the 7th International Conference on Electronic Commerce, August 15-17, 2005, ACM, Xi'an, China, ISBN:1-59593-112-0, pp: 52-56.

Zhang, Z. and Q.L. Xu, 2011. Universal composable grouping-proof protocol for RFID tags in the internet of things. Chinese J. Comput., 34: 1188-1194.

Zmud, J., J. Wagner and M. Moran, 2016. License Plate Reader Technology: Transportation Uses and Privacy Risks. AASHTO, Washington, DC., USA., Pages: 88.