Socialize the Behavior of IOT on Human To Devices Interaction and Internet Marketing

Jahangir Jabbar[1], Hussain Mehmood[2], Umaima Hafeez[3], Hassaan Malik[4], Humayun Salahuddin[5] , Taimoor Hassan Jabbar[6]

jahangir2002@hotmail.com h_m_khokher@hotmail.com

[1,2,3] National College of Business Administration & Economics (NCBA&E), Multan, Pakistan

[4]School of Systems and Technology, University of Management & Technology (UMT), Lahore, Pakistan

[5] Department of Computer Science, HITEC University Taxila, Pakistan

[6] Bahauddin Zakariya University, Multan, , Pakistan

Abstract

This paper explored the developments in SIOT and IOT to meet growing industrial demands. Advancements in the processing power of devices, cost and availability of fast and affordable internet have led to magnification in Internet of Things- Here objects are given capabilities to transfer data/information. The performance of objects can be improved with enhanced capacity to socialize (Internet of Things) via objects to establish social relationships between other objects to visualize human behaviors. Social Internet of Things (SIOT) has emerged to give objects within an IOT eco-system, capable to communicate with each other in the same way human being interacts in daily life. More significant additions are witnessed to address multiple issues in this area came due to major developments in SIOT and IOT based architecture aided by latest communication technologies. Moreover, both are reliable, efficient and secure to meet variable nature of real time applications.

Keywords

Social Internet of Things (SIOT), Internet of Things (IOT), IOT ecosystem.

1. Introduce

Developments in IoT technologies and availability at lower prices booming the devices connectivity and remote ease of use. Thus, the adaptation of standards are crucial to allow communication among these heterogeneous systems in IoT [1].

Internet of Things is defined as the interconnection of everyday objects through the internet of computing devices to enable such objects to send and receive data[6]. It can also be described as a system of inter-related mechanical, digital, computing machines, people, animal and objects that have been fitted with unique identifiers and can transfer data over their network/system without need for human-to-computer or human to human interaction[21]. The elegance and communication ability of IoT devices offer many valuable applications to ordinary people, companies, industry and governments [2]. The IOT industry is being fueled by the massive developments in technology and the capability to connect billions of devices. IT field is growing at a phenomenal rate given that there were about 15 billion interconnected devices in 2015, the number rose to 23 billion in 2018 and the projections are that it will hit 62 billion devices by 2025.

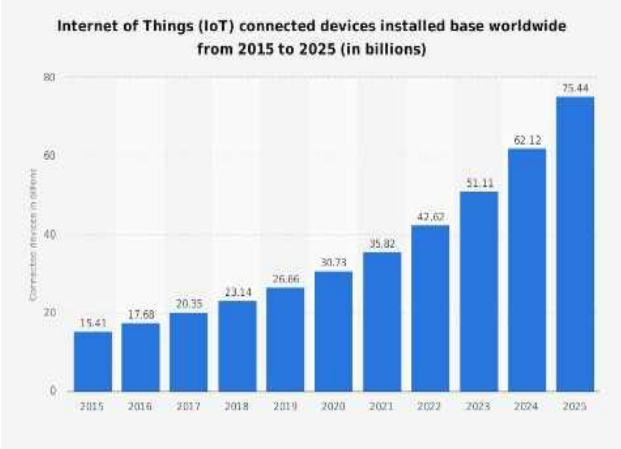

Fig. 1 IOT Devices World Wide

The IOT industry is one of fastest growing industries in the world with billions of dollars invested every year [7].

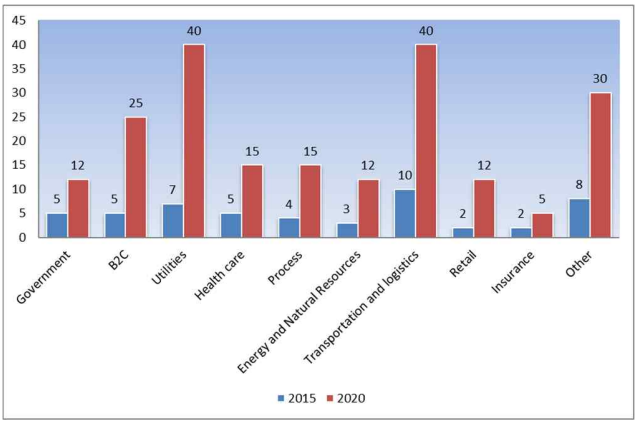

Fig. 1.1 IOT Industry

Manuscript received May 5, 2020
Manuscript revised May 20, 2020

The industry sectors that have realized the major potentials are manufacturing (84%), energy and utility industry (41%) increment in IOT based network connections. Transport and distribution as well as smart cities and communities are 40% and 19% respectively. The healthcare/pharmaceuticals are among top five industries using IOT extensively with11% rise on annual basis.

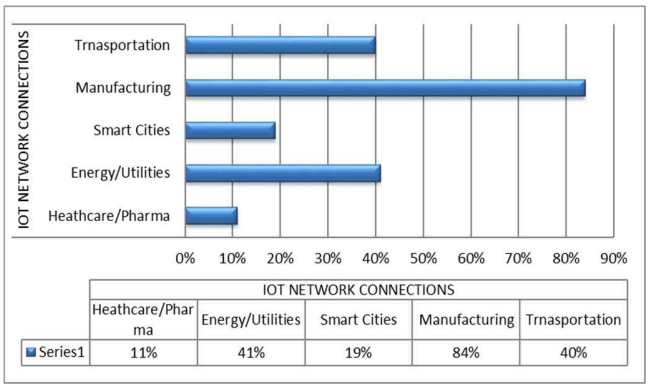

Fig. 1.3 IOT Network Connections

Social Internet of Things (SIOT) can be termed as Internet of Things (IOT) in which things have been given capabilities of establishing social relationships with other things in autonomous ways with respect to humans [13]. SIOT stems from the knowledge through scientific evidence gained by group of people in a social network are in a better position to offer more accurate answers to complex issues compared to individuals. Principle of bringing things and people together has been used in many ways to harness synergies of networks and it has gained widespread appreciation in internet-related domains.

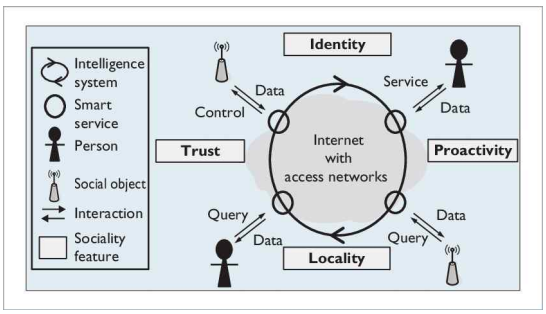

Fig. 1.4 SIOT Framework

The above figure shows that SIOT will be based on four main pillars:-

- Identity
- Locality
- Proactivity
- Trust

The implementation of IOT has been based on the power and efficiency that comes from networking related or non-related things to achieve autonomy and ensure systems run without human interruption (intelligence) to make human lives easier and more valuable. This paper explores SIOT for various ways in which it is currently being implemented, how efficient it is predicting, various challenges developers and implementers (stakeholders) are facing and how to make changes in SIOT environment. The next detail analysis of the qualitative information gathered, while remaining sections detailing the limitations and future developments anticipated in the study topic.

2. Background

In near future computing and internet will found or exists everywhere on earth and this going to usher an era of many smart applications to help make human lives more comfortable. New challenges are occurring in communication as population rise and businesses increases. While telecommunication devices are improved a great deal, there will be need for technology to come in and connect people remotely to things and objects they need and use in their daily lives. The question has been how to use the SIOT applications and services. Two considerations are shown as a solution to effective SIOT- First one is improvement in pervasiveness or availability of SIOT services in diverse parts of world- where some people are not left out due to costs, technical expertise required to set up and maintain the SIOT or where the SIOT fails to include unique social-economic activities and cultures among its capabilities. Second is how to grow connectivity without compromising security and effectiveness of already connected devices and systems. In human societies people function as the producers and the consumers of communication and socialization with other people. In case of SIOT the devices have to acquire processors and other components to enable them authentically generate and consume communication and socialization in a manner that does not negate the way they are set to operate by their human controllers. Devices need capabilities to store, process and use social aspects.

SIOT has become a common topic of interest whenever IOT is mentioned because of its rapid advancements in IT and desire to incorporate social relations with technology. Computer processors- genesis or determiner of computing power- have become progressively smaller year by year and hence enabling their insertion into smaller devices – laptops, mobile phones, tablets and even in smart watches. The processor cost have also gotten cheaper with advancements in technology. A processor is a component in computing devices that receives inputs and provides the required outputs- it acts as the primary coordinating component in computing devices. For instance, Intel's i486 used to cost the

price of a small car but now its price matches that of a chocolate bar![21]. As processors gets smaller and cheaper with significant rise in processing power. Processors can be increasingly placed where they could not be adopted previously. This is the genesis of IOT and subsequently SIOT. Many companies across the world are using processors in telephones, bedside lamps, electricity meters and even teddy bear etc. for smarter performance to interact with various situations in lesser amount of time. It is collectively making the objects "intelligent" with smarter approach.

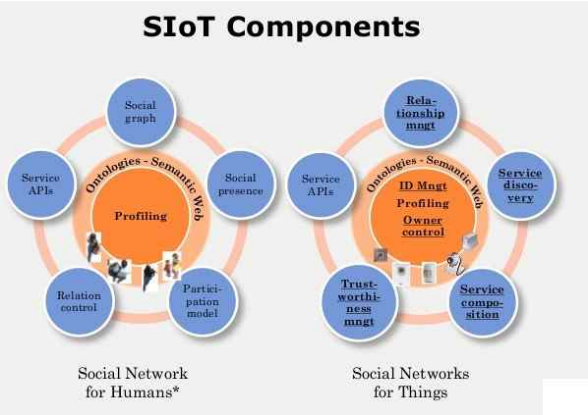

Fig. 2 IOT Components

While the social network for humans comprises of service APIs, relation control, participation model, social presence and graphs that are combined through a semantic web, Social Internet of Things (SIOT) comprises of relationship management, service discovery, service composition, effective management and service APIs. A semantic web made up of identity management, profiling and owner control brings these SIOT components aligned.

However, as more people interact through social media, user want technology to aid in enhancing social or human-to-human connections and global relationships. Scientists and technology experts have been investigating and implementing systems that can make IOTs virtual with locatable addresses and readable over the internet. This approach makes objects within an IoT system to communicate and provide customer services to achieve common goals [13]. make the following observations in response to the issues that developers anticipate of SIOT-where object interacts with other objects to serve common interests, objects craw and gather information from billions of other objects to discover information and offer services in an improved manner and they could advertise their presence and services can be offered to rest of the networks.

There are three main areas where SIOT will find major applications:-

- Society focused applications- Telecommunication, healthcare services, entertainment, homes, ticketing, smart buildings and education.
- Industry focused applications- These include transportation, supply chain management, aerospace, automotive, factories, manufacturing and aviation industry.
- Environment focused applications- recycling, breeding, agriculture and disaster prediction related matters.

The world has already seen numerous smart devices and systems that waits for mass development of smart things to socialize. SIOT is currently designed to tap communication channels, their cell phones or native applications that one can install on a phone, laptop or tablet. One can use SIOT to send emails post on social media sites or chat on messaging apps depends upon time and location of IOT devices have been set to be fixed. There're a lot of communication applications in various countries that are setting the pace for SIOT.

For instance KakaoTalk in Korea is an advanced instant messaging application established in 2010 that offers free social interaction tools. KakaoTalk users can send messages, talk free, access games, music, send photos, videos and voice messages in addition to sharing locations and make payments [8].

This application additionally encourages users for making a schedule to chat with members, make conference calls, schedule errands and make online reservations. Other countries have their equivalent of advanced social applications that currently form the basis of what can be improved for advanced SIOT. These include hike in Brazil, America's Whatsapp and Line in Japan are popular examples. In all these cases, SIOT is allowing users to control different connected devices at home and at work using tweets and messages in text or in voice. SIOT is currently allowing people to control technology eco-systems regardless of the operating systems (Android vsi OS) or the manufacturer (Samsung, Huawei etc). The ultimate plan for SIOT is having people to add cars, homes and even the city in which one lives other things to their list of contacts (friends, relatives and colleagues) and thereafter have "conversations with all different devices"[9].

The advancements in SIOT has shown the following advantages:-

- Increment in the levels of trustworthiness between networked things and human users.
- Lessen human labor to accomplish various tasks.
- Reduce the costs associated with assigned tasks to minimize cost of expenditures on utilities such as water and electricity.

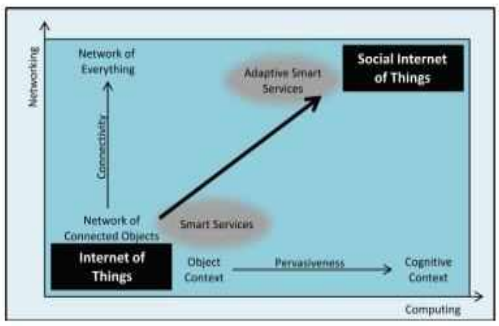

Fig. 3 Evolution of SIOT

The above figure shows that increment in connectivity of SIOT applications between communities and individuals has been met with increments in pervasiveness. Additionally there is increment in cognitive contexts (integration between subjective and objective contexts) which has been a great improvement or development from IOT to SIOT.

3. Literature Review

Open challenges include data integrity, authentication and access mechanisms. Quick development, deployment, testing and adaptation to recent proposed security standards are necessary to offer the ultimate network security [1].
Communication need of wireless technologies makes the IOT at risk to cyber-attacks. Forensic solutions can help identify the root causes of attacks and the perpetrators. Forensic result with in its architecture to make sure a safe and secure environment or else, users may sabotage their trust in IoT-based structures [2].
Connection between IOT and social technologies is formed with Infrastructure to ensure minimal human-computer interaction(HCI) is necessary and needs smarter functions to meet higher degree of human-computer interfaces(HCIs) as the drivers of an effective SIOT [3].
Other approach addresses security and privacy in (IOT)- as IOT stands to revolutionize people's entertainment, health and government dealings it also poses the challenges of security and freedoms. There is a need to develop secure infrastructure that can be standardized, organized in the form of policies and governable with room for improvement [4].
With the development of IOT, we're more curious about its security and privacy issues
Due to the extensive availability and production of the SHS (smart home system) , attackers can impersonate as a homeowner to steal important data (e.g., vital signs) for doing extortion and life threatening. A new technology called Block chain, is growing to prevent the security leak. By adopting the Block chain method, home owner or users can verify every transaction history that has already done inside of their SHS [5].
Another approach identified that in the Healthcare sector IOT can be applied to bring plenty of convenience to patients and physicians. Social IOT aided by Radio Frequency Identification (RFID) can be used to help IOT devices to communicate about medical emergency management, patient information management, blood information management among other features to be handled. Security requirements of RFID in IOT and SIOT have compelled the development of several authentication schemes with one of the best effective being Elliptic Curve Technology (ECT) [10].
Machine to Machine (M2M) communications are core of enabling networked devices to socialize and exchange information. Cognitive radio technology is at the heart of aiding SIOT such as the standardization of M2M communications ought to be given priority by stakeholders in the SIOT environment. The proposed solution is to centralize cognitive Media Access Control (MAC) protocol [11].
Many systems tested for location based services for mobile phones. The result shows that internet enabled phones, sensors that provide location Furthermore rise in processing power of digital devices makes them suitable for SIOT and IoT. A novel localization scheme known as NextMe based on mobile phone trackers using mobile call patterns. The correlation counts as social interplay and it can form the ground for temporal and spatial perspectives. The Scheme used MIT Reality Mining Dataset captured over 500,000 hours and 112,508 calls [12].
Social networks exist as a foundation of reliable and global IOT. The social networks acts as a bridge that links human to device interactions. The research explores a novel paradigm for ubiquitous computing capabilities [14].
IOT focuses on equipping objects with sensors to enable hear, see and smell senses applied on real world for themselves and can take responsive actions. However, beyond mimicking human senses, objects ought to think, learn and understand on their own intelligence. As such it suggests that a cognitive internet of Things (CIOT) is the best way to give "brains" signals towards objects and aid them in socialization [15]. CIOT follows five tasks:

- massive data analytics
- perception-action cycle
- knowledge discovery and semantics derivation
- intelligent decision making
- provision of services on demand.

The research by Cirani et.al focused on the possibility of creating robust applications and a range of smart objects deployment and interconnection eliminates the necessity of human intervention for their configuration and maintenance. The proposed solution is self-configuring and scalable peer-to-peer based architecture could be applied in larger scale

SIOT and IOT networks. The envisaged architecture is targeted at offering more automated services and mechanisms for resource discovery for systems that do not need human intervention for configuration purposes [18].
Differential fault analysis becomes a critical way of evaluating security levels of cryptosystem in IOT due to fast speeds in IT and simplification of IT. Serpent- a 128 bit Substitution Permutation Network (SPN) cryptosystem. The system is capability to provide secure [19].
SIOT would work better in a scenario where objects within an IOT ecosystem generate its functions and reactions from the behaviors of individual objects.
The researchers also addressed the capabilities of a SIOT system to isolate malicious nodes and objects to affect desires feedbacks. Social networks and Peer to Peer (P2P) P2P are models suggested to grow trustworthiness between objects. The goal is to create a system in which the actions of each object can be predicated with a higher degree of precision by human controllers of the system [20].

Table 1: Siot Comparative Analysis

Authors/ Researchers	Identified Issues	Proposed, operations, Architecture, manageability and maintenance
Zikria et al (2019)	Open challenges include data integrity, authentication and access mechanisms	Quick development Deployment Testing and adaptation to recent proposed security standards are essential to provide the ultimate network security.
Yaqoob, I., et al (2018)	Communication dependency of wireless technologies makes the IOT vulnerable to cyber attacks	Forensic solutions can help identify the root causes of attacks and the perpetrators
Mendhurwar, S. Rajhans, M. (2018)	Connection between IOT and social technologies.	Infrastructure to ensure minimal human-computer interaction is necessary and needs automation.
Maple, C. (2017)	Article addresses security and privacy in the internet of things- the authors note that although IOT poses the challenges of security and freedoms.	There is a need to develop secure infrastructure that can be standardized, organized into policies and governable yet with room for innovation.
Aung, Y. N., & Tantidham, T. (2017)	Security and privacy issues	A new technology called Block chain, is rising to prevent the security leak. Proposed the idea of how to apply Block chain for SHS
Aijaz & Aghvami (2015)	M2M Issues Standardization of M2M communications Cognitive radio technology	The research proposed that a centralized cognitive Media Access Control (MAC) protocol.
Debiao & Zeadally (2015)	Healthcare Sector IOT Social IOT aided by Radio Frequency Identification (RFID) Patient information management Blood information management	The security requirements of RFID in IOT and SIOT have compelled the development of several authentication schemes with Elliptic Curve Technology (ECC).
Daqiang et al (2015)	Location based services for mobile phones. Researchers propose a novel localization scheme known as NextMe that is based on mobile phone traces using mobile call patterns.	NextMe does not need tower addresses to be bounded together with Global Positioning System coordinates. The Scheme used MIT Reality Mining Dataset captured over 500,000 hours and 112,508 calls.
Cirani et al (2014)	Possibility of creating robust applications and a range of smart objects Eliminates the necessity of human intervention for their configuration and maintenance.	Self- configuring and scalable peer-to-peer based architecture can be applied on larger scale SIOT and IOT networks. The envisaged architecture is targeted at offering more automated services and mechanisms for resource discovery for systems.

Li et al (2014)	Differential fault analysis becomes a critical way of evaluating the security levels of cryptosystem in IOT due to fast speeds in IT and the simplification of IT.	Serpent- a 128 bit Substitution Permutation Network (SPN) cryptosystem. The system has the capability to provide secure IOT.
Nitti, Girau & Atzori (2014)	The researchers also addressed the capabilities of a SIOT system to isolate malicious nodes and objects to effect desires feedbacks.	Social networks and Peer to Peer (P2P) P2P are the models suggested to grow trustworthiness between objects. The goal is to create a system in which actions of each object and at each part can be predicated with a higher degree of precision by human controllers.
Ortiz et al (2014)	Non-existence of Social networks as the best foundation upon which to build reliable and global IOT. Explores the novel paradigm for ubiquitous computing capabilities.	Generic SIOT architecture
Qihui at al (2014)	Cognitive internet of Things (CIOT) would be the best way to give "brains" to objects and aid them in socialization.	Architecture is proposed to aid such CIOT follows five tasks: massive data analytics perception-action cycle knowledge discovery and semantics derivation intelligent decision making Provision of services on demand.

It can be noted from different studies that plenty of groundwork has been done in establishing IOT and SIOT ought to work. For instance, the role of internet-enabled mobile phones has been highlighted as playing a central role in SIOT. Moreover, currently usable social networks especially instant messaging applications such as whatsapp, facebook, twitter and kakaotalk is critical in the journey towards the full realization of global SIOT.

4. Conclusion

Global IOT market is set to grow from $157 billion in 2016 - $457 billion by 2020. It will translate to annual growth rate of more than 28.5% with the annual contributions growing by $300 billion annually by the year 2020. IOT Technology has advanced at a phenomenal rate in the last 2 decades especially since the invention of the internet. Around 7 billion people on the earth are currently operating more than 20 billion IOT devices. Social Internet of Things (SIOTs) is providing a medium for objects in IOT to socialize and communicate with each other as human to human routine life interactions. The review revealed major burning issues including - Routing issues (hop-to-hop routing and source routing) can be transformed as industry communication standards for SIOT and IOT. Current routing protocols need harmonization to establish more reliable, comfortable and cost-effective routing methods can be applied in progressing world. Industry sectors like manufacturing, energy and utilities, transport and distribution, smart cities and communities, healthcare/pharmaceuticals are experiencing great feedback due to massive developments in SIOT (architecture, operations and maintenance). Moreover, future works will need to address smart sensor deployment for data acquisition, faster computation and secure communication protocols by using more advanced methods beyond the current 3G or 4G technology. Machines are required to work in a robust and frictionless manner. A standard interface is required to foster more innovations to improve SIOT ecosystems.

References

[1] Zikria, Y. B., Kim, S. W., Hahm, O., Afzal, M. K., &Aalsalem, M. Y.(2019). Internet of Things (IoT) Operating Systems Management:Opportunities, Challenges, and Solution.

[2] Yaqoob, I., Hashem, I. A. T., Ahmed, A., Kazmi, S. M. A., & Hong, C.S. (2018). Internet of things forensics: Recent advances, taxonomy,requirements, and open challenges. Future Generation Computer Systems.

[3] Mendhurwar, S. & Mishra R. (2018) "Emerging Synergies Between Internet of Things and Social Technologies" Journal of Global Information Technology Management. Vol. 21. Issue 2.

[4] Maple C. (2017)"Security and Privacy in the Internet of Things"Journal of Cyber Policy. Vol. 2. Issue 2.

[5] Aung, Y. N., &Tantidham, T. (2017). Review of Ethereum: Smart home case study. 2017 2nd International Conference on Information Technology

[6] Bouhaï, N., & Saleh, I. (2017). Internet of Things: Evolutions and Innovations. John Wiley & Sons.

[7] Columbus, L. (2017). 2017 Roundup Of Internet Of Things Forecasts. Retrieved May 31, 2019, from https://www.forbes.com/sites/louiscolumbus/2017/12/10/2017-roundup-of-internet of things-forecasts/#64bb884a1480

[8] Williams, M. (2017). What You Should Know About KakaoTalk. Retrieved May 28, 2019, from https://www.addthis.com/blog/2017/12/01/what-you-should-know-about-kakaotalk/#.XOz-PBYzbIU

[9] Herron, K. (2016). When social media meets the Internet of Things: Is Social Keeping Global IOT Adoption from Its Tipping Point. . Retrieved May 28, 2019, from https://uib.ai/when-social-media-meets-the-internet-of-things/

[10] Debiao He; Zeadally, S. (2015).An Analysis of RFID Authentication Schemes for Internet of Things in Healthcare Environment Using Elliptic Curve Cryptography vol.2, no.1, pp.72-83

[11] Aijaz, A.; Aghvami, A.H. (2015).Cognitive Machine-toMachine Communications for Internet-of-Things: A Protocol Stack Perspective. vol.2, no.2, pp.103-112.
[12] Daqiang Zhang; Shengjie Zhao; Yang, L.T.; Min Chen; Yunsheng Wang; Huazhong Liu. (2015).NextMe: Localization Using Cellular Traces in Internet of Things.vol.11, no.2,pp.302-312
[13] Aztori, L., Iera, A.,& Morabito, G. (2014)"From 'Smart Objects' to 'Social Objects': The Next Evolutionary Step of the Internet of Things."IEEE Communications Magazine, P. 97-105.
[14] Ortiz, A.M.; Hussein, D.; Soochang Park; Han, S.N.; Crespi, N. (2014).The Cluster Between Internet of Things and Social Networks: Review and Research Challenges.vol.1, no.3, pp.206-215
[15] Qihui Wu; Guoru Ding; Yuhua Xu; Shuo Feng; Zhiyong Du; Jinlong Wang; Keping Long . (2014).Cognitive Internet of Things: A New Paradigm Beyond Connection.vol.1, no.2, pp.129-143
[16] Jiong Jin; Gubbi, J.; Marusic, S.; Palaniswami, M. (2014).An Information Framework for Creating a Smart City Through Internet of Things.vol.1, no.2, pp.112-121.
[17] Hao Yue; Linke Guo; Ruidong Li; Asaeda, H.; Yuguang Fang, (2014).DataClouds: Enabling Community-Based Data-Centric Services Over the Internet of Things.vol.1, no.5, pp.472-482.
[18] Cirani, S.; Davoli, L.; Ferrari, G.; Leone, R.; Medagliani, P.; Picone, M.; Veltri, L. (2014).A Scalable and SelfConfiguring Architecture for Service Discovery in the Internet of Things.vol.1, no.5, pp.508-521
[19] Li Wei; Tao Zhi; Gu Dawu; Sun Li; Qu Bo; Liu Zhiqiang; Liu Ya. (2014). An effective differential fault analysis on the Serpent cryptosystem in the Internet of Things. vol.11, no.6, pp.129-139.
[20] Nitti, M.; Girau, R.; Atzori, L. (2014).Trustworthiness Management in the Social Internet of Things.vol.26, no.5, pp.1253-1266.
[21] McEwen, A., & Cassimally, H. (2013). Designing the Internet of Things. John Wiley & Sons.