

A Review of Current Trend on Data Management and Quality in Data Communication

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Abstract: Data communication is one of the areas that can be explored by researchers in the current digital world. The aspects of data communication could be divided into several categories such as the acquisition, transmission, processing, storage, etc. This paper reviews some of the previously written papers related to enhancement in data communication technology published between 2007 and 2012 in IEEE Explorer, Science Publications and ACM. However, only 33 of the above papers are considered for this review. In this paper, data communication aspects are divided into three categories namely (a) data processing, (b) data transmission and (c) data monitoring and control. Based on the review, the current data management requires fast and quick processing, transmission and retrieval. This is due the the change of paradigm from centralized to mobile data storage and retrieval and also the volume of data that is always increasing that requires better and fast result for organizations. This paper presents the current trend of data management and quality in data communication. The challenge posed by current data communication advancement through emerging mobile device and application become new research opportunities for researchers to create or to improve current method of data processing and retrieval.

Key words: Data management, data communication, data processing, data transmission, data quality.

INTRODUCTION

In today's world, electronic communication has become part of human life not only in business but also in social or personal activities. Some popular electronic communications are like email, Facebook, YouTube, Twitter, Friendster, business websites, e-commerce, and many more. Electronic communication is defined as communication using computers which involves transmission of data or signals that have been encoded digitally either for storage or processing by computers (Thefreedictionary, 2012). The types of data here could be referred to those used for video, still images, audio, text or their combinations that are transmitted using internet, mobiles or other digital communication devices.

Despite of growing usage of data communication in human lives, some researchers have realized that there are some weaknesses in the existing data communication technology.

Based on articles listed in the reference list of this paper, it is learnt that researchers have studied and proposed several improvements in the areas of data control, monitoring or acquisition, distribution or transmission, and processing. Ideally, data to be communicated should be well processed before they are transmitted in efficient and cost effective ways either for monitoring or controlling activities. Thus, it is practical to separate this review into categories existing in data communication technology.

The next part of this paper, we will explain the enhancement activities related to the categories of data communication as mentioned in the previous paragraphs followed by results of review and overall conclusion.

MATERIALS AND METHODS

Data communication in general describes the technology used in data transfers through communication channels. In this review, data communication is classified into three classes such as data processing, data transmission and data monitoring. In each classification, some evolution of each category can be seen in which it is discussed based on the publications that are later than 2008. There are Table 1 shows the reviewed publications on current trend of data management and quality in data communications.

Data Processing:

For a very critical situation like save and rescue mission, data processing is critical and it is needed to be available quickly. Apart from the speeding up the processing, supporting component is also important to speed up processing the critical data. For example, Koch *et al.* (2007) proposed an approach called Rapid and Precise Mobile Data Processing for Fire Brigades and Rescue Services. This design exploits the mobile data processing to provide general data and technical knowledge to the rescue task force to support and improve emergencies and

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rescue cases. There are many input data that needed to be processed to assist decision making for the fire-fighter in the rescue mission. Every data from chemical compound of any leaking in the rescuing site to the geographical location of the site have to be considered to make a critical and helpful decision for the firemen to plan their rescue. One of the means to support quicker data processing in this approach is it uses both the UMTS (Universal Mobile Telecommunications System) and WLAN to access the knowledge based which is free of time and location constraint. Another support for quicker processing is through the availability of database that stores firemen's past experience that can be used in other similar situation.

Table 1: Data Communication Distribution.

Category	Title	Year Published	
Data processing	Brigades and Rescue Services (SAFeR/GÜTER/SHARE)	2007	
	Quadtree-Based Approach to Data Distribution Management for Distributed Simulations	2008	
	Design of Modified Adaptive Huffman Data Compression Algorithm for Wireless Sensor Network	2009	
	Conventional CDSS only focus on diagnosis assistance. It usually utilize static knowledge base and neglect the feedbacks from the patients	2011	
	Secure Data Processing Framework for Mobile Cloud Computing	2011	
	Efficient Sensor Stream Data Processing System to use Cache Technique for Ubiquitous Sensor Network Application Service	2012	
Data transmission	Rapid and Precise Mobile Data Processing for Fire		
	On Link-Layer Reliability and Stability for Wireless Communication	2008	
	Bluetooth Wireless Network Authentication Using Radio Frequency Communication Protocol	2009	
	DoIP Interfacer System: A Low-Cost Alternative to Computer for Basic Network Communication in LAN Environment	2009	
	Wireless Communication with a Microprocessor Based Ultrasonic Meter for Flow Measurements	2009	
	Multimedia Data in Hybrid Vehicular Networks	2010	
	An Analytic Throughput Model for TCP NewReno	2010	
	Secure data transmission using Steganography based data hiding in TCP/IP	2011	
	Wireless Body Area Sensor Networks Signal Processing and Communication Framework: Survey on Sensing, Communication Technologies, Delivery and Feedback	2012	
	Data monitoring and control	Development of a Bed Sensor for an Integrated Digital Home Monitoring System	2008
		Integrating a Bed Sensor in a Smart Home Monitoring System.	2008
		A Wireless Sensor Network Compatible Wearable u-healthcare Monitoring System Using Integrated ECG, Accelerometer and SpO2	2008
		Using Public Mobile Phone Networks for Distribution Automation (DA)	2008
		Web-based decision making for collaborative manufacturing.	2009
		Web based poultry farm monitoring system using wireless sensor network.	2009
		Representing Data Quality in Sensor Data Streaming Environment	2009
		System Design and Analysis of a Web-Based Application for Sensor Network Data Integration and Real-Time Presentation	2009
		Increasing energy awareness through web-enabled power outlets	2010
		An integrated system for on-line intelligent monitoring and identifying process variability and its application	2010
		Mobile Monitoring System for Smart Home	2010
		Towards the Development of a Cognitive Sensors Network-based Home for Elder Care	2010
		Collaborative Web-Based Architecture for Real-Time Monitoring of Sensor Data	2010
	Modeling and assessing quality of information in multimedia monitoring systems	2011	
	Development of On-line Monitoring System for SF6 Circuit Breaker	2011	
	Mobile Element Scheduling for Efficient Data Collection in Wireless Sensor Networks: A Survey	2011	
	Web services-based automation for the control and monitoring of production systems	2010	
	Design and Reliability Test of a Wireless System to Monitor and Control High voltage Switch Cabinets	2010	
	Design of On-line Interactive Data Acquisition and Control System for Embedded Real Time Applications	2011	

In data processing activity, the collected data are also analyzed or manipulated before next actions are taken. Some researchers intelligently analyzed the data before further utilization. One example of this approach is the research proposed by Omer *et al.* (2008) through an approach called Quadtree-based Approach to increase the efficiency of data transfer by eliminating unnecessary data before they are being transferred or distributed. This design has shown better performance in data communication compared to the existing Data Distribution Management (DDM) methods because it manages to reduce some computational activities and system complexity which help to speed-up the data transfer process.

Believe it or not, power utilization efficiency can be improved just by improving data processing especially in the field of Wireless Sensor Network (WSN). Tharini and Ranjan (2009) have designed a method to extend the lifetime of batteries used in sensor nodes. They believe that sending more data by sensor nodes will cause more energy to be consumed and as a result the battery lifetime will be shortened. They have introduced a technique to compress the data by modifying an existing algorithm for WSN called Adaptive Huffman. By compressing sensor

data, number of bits transmitted by sensor nodes is reduced and this will result in lesser utilization of energy for data communication.

In medical field, an improvement in data processing can help medical practitioners give their patients a more reliable diagnosis. Fatima *et al.* (2011) realize that the clinical data collected using the existing Socially Interactive CDSS (Clinical Decision Support System) is not good enough to diagnose patients because it is just based on the static knowledge. To improve this, the authors have come out with a set of their own inference engine based on feedbacks obtained from patients. This means feedbacks collected from patients are being manipulated using a module they developed called Knowledge Authority Module (KAM) before any diagnosis are made for patients. With this method used, patients are more confident about the health conditions diagnosed to them. However, data processing for personal or critical data needs to be secured and privacy of the data must be kept especially in the medical field. Huang *et al.* (2011) proposes a framework for secure data processing in a cloud environment. The proposed framework is using the ESSI or Extended Semi-Shadow Images which is a virtual machine for the users to control their data in a virtual disk. A trusted domain of cloud is also implemented in the framework to filter malicious traffic before going into the cloud.

In environmental monitoring or building surveillance activities, continuous monitoring system is necessary. This will require data to be sent on periodical basis for a certain length of period. One of the technologies exist is known as Ubiquitous Sensor Network (USN) that can transfer data from small sensors using wireless network. However, this has caused excessive data sent to database due to repetitive data transferred by sensor nodes, periodically. Park & Oh (2012) have come out with sensing cache technique that can reduce redundant database processing and operation caused by high number of events occurred on the same nodes. This improvement has eventually reduced the cost consumed to run this operation.

Data Transmission:

Data distribution and transmission can be performed using wired, wireless or the combination of both. Wireless data transmissions include data transfer using mobile, internet or intranet facilities whereas wired data communication can be done using fixed and connected network facilities. Either ways, there are still many shortcomings that could be looked into for further improvements.

Researchers have done a lot of studies to reduce these shortcomings. Recently, researchers are more interested to do improvements in wireless rather than in wired communication system. They have proposed improvements to ensure data are effectively transmitted with either adequate throughput, secured environment, or cheap communication cost.

Soltani *et al.* (2008) have discussed on how to make wireless communication become more stable and reliable especially in sensor network system. The authors has suggested using Automatic Code Embedding (ACE) wireless link-layer protocol in order to achieve maximum throughput with better reliability and stability of the systems especially those with high number of sensors. However, Iskandarani (2009) are more interested in using infra-red technology as a suitable short range communication for effective data transfer from Flow Meters. When a lot of data are being transferred through internet using TCP (Transmission Control Protocol), they are prone to have network congestion. Thus, Parvez *et al.* (2010) have introduced a technique to control the congestion by increasing congestion window size if additional bandwidth is available on the network.

While Waleed *et al.* (2009) introduce a secured data transmission using Bluetooth communication system, Goudar *et al.* (2011) introduce a technique of using information hiding to secretly send messages through network using network control protocols. It is done by first identifying the redundant bits in a cover-object and replacing them with message bits before the object (embedded with secret messages) is transferred to the targeted recipients.

Even though Tay *et al.* (2009) stress that a cheaper data communication method could be achieved without using any computer especially in Local Area Network (LAN) communication system, Al-Saud *et al.* (2012) have made a study that the data could be cost-effectively transferred by using the hybrid technology - the combination of both short range communication (i.e. using Bluetooth or Zigbee) and long range communication (i.e. using Wi-Fi, Wimax or 3G). Xu *et al.* (2010) added that the communication cost can be reduced a lot if the frequency of mobile usage is minimized while the use of Wi-Fi is optimized. This is due to subscribing mobile facilities is normally more expensive than using any short range communication facilities.

Data Monitoring and Control:

In recent digital communication technology, data monitoring or control are normally done either using web-based application or mobile communication system. Even though, the web-based communication system seem to be more popular among Murad *et al.* (2009), Morreale and Suleski (2009), Weiss and Guinard (2010), Du *et al.* (2010), Gadea *et al.* (2010), Phaithoonbuathong *et al.* (2010) as well as Manimaran and Kumaresan (2011). While other authors like Gaddam *et al.* (2008), Chung *et al.* (2008), Khandare and Mahajan (2010), Hossain *et al.* (2011), Jin *et al.* (2011), Gandhi and Narayanasamy (2011), Vaishnav *et al.* (2008), Kou *et al.* (2010) are more interested in mobile communication method.

Since it is very important to be able to collect data on real-time basis, especially when dealing with remote signals, researchers seemed to be interested in applying web-based monitoring in environmental or industrial surveillance activities as illustrated by Murad *et al.* (2009), Morreale and Suleski (2009), Weiss and Guinard (2010), Du, Lu and Xi (2010) as well as Phaithoonbuathong *et al.* (2010). In addition, Manimaran and Kumaresan (2011) have come out with a system called IDACS (Interactive Data Acquisition and Control System) to remotely measure signals and control devices using web-application. This has reduced the need to manual data collection at remote sites because it can be done through internet in which the data can be electronically stored directly into information system. The operators can be anywhere in the world to collect the required information that could be located thousands kilometer away from them. This is a very good achievement because not only the user can collect data quickly but also a lot of cost or resources such as traveling cost, man-hours, etc. could be reduced or eliminated.

There are also non web-based articles related to real-time monitoring. Even though the application of mobile communication is considered to be more expensive than the communication by using internet, it has becoming more useful in health surveillance as demonstrated by Gaddam *et al.* (2008) and (2010), Chung, Lee and Jung (2008), and Khandare and Mahajan (2010). This could be due to the importance of saving human lives in rather than saving a lot of money.

Majority of the reviewed articles discussed about the improvement related to data monitoring instead of data controlling activities. It looks like obtaining data or information has obtained a higher attention among current researchers than sending out data or instructions to control equipments. Furthermore, the monitoring based on real-time basis seems very much used by medical practitioners to monitor patients' health conditions. On the other hand, even though the authors do talk about control systems; they don't really give much idea on its improvement technique. Thus, there is still lacking of knowledge on improved data communication methods for controlling purposes.

RESULT AND DISCUSSION

There are many aspects that digital data communication can be improved. This paper addresses the explorations done by researchers in the areas of data processing, data transfer or transmission as well as data monitoring and control. In general, people are normally interested in having fast, accurate, secure and cost effective deals with data communication.

In data processing, the researchers not only interested in ensuring data are properly, consistently and intelligently evaluated and analyzed before they can be transferred for further utilization by the intended users but also trying to shorten the delivery period and with lesser cost incurred.

The above papers have indicated that data could be transferred or communicated using wired, wireless or the combinations of both network connections. However, wireless data transmission method is becoming more popular among researchers. One of the successful discoveries by researchers is the introduction of IDACS that can acquire data from every where in the world quickly and in a cost effective manner. It is also learnt that short distance wireless communication is less expensive than that of long distance because the latter requires mobile (e.g. GSM) communication network in which the subscription fees are normally more expensive. Several authors for the above papers have proposed ways to communicate data in not only cost effective and efficient but also fast manner regardless of data size.

Currently, many research improvements have been done in medical field, industrial sectors as well as smart homes which involve controlling and monitoring of data especially on real-time basis. However, research related to the control of devices is not much compared to the monitoring aspects. This could be left for future explorations by researchers.

Conclusion:

Based on the review, there is a need for efficient data management and quality in data communication. With the emergence of mobility in communication that includes the usage of high-powered smart phones and tablets, fast and efficient processing and retrieval of data is needed especially by the current users who are very much involved with current data communication advancement through emerging mobile device and application. The challenge posed by this demands become the research problem for researchers to create or to improve current method of data processing and retrieval. With the availability of high speed Internet and cheaper data storage, proper data processing and management is needed to cater such high volume of data that includes not just texts data but also data such as high resolution video, images, and also audio. Indeed, the importance of data management never fade away, instead it becomes even more critical and it is required to have a better data processing and quality to match the advancement data communication.

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