Chapter 45
Secure Image Processing and Transmission Schema in Cluster–Based Wireless Sensor Network

Mohamed Elhoseny
Mansoura University, Egypt & Scientific Research Group in Egypt (SRGE), Egypt

Josep Batle
Universitat de les Illes Balears, Spain

Ahmed Farouk
Zewail City of Science and Technology, Egypt & Mansoura University, Egypt

Abdulaziz Shehab
Mansoura University, Egypt

Aboul Ella Hassanien
Cairo University, Giza, Egypt & Scientific Research Group in Egypt (SRGE), Egypt

ABSTRACT

WSN as a new category of computer-based computing platforms and network structures is showing new applications in different areas such as environmental monitoring, health care and military applications. Although there are a lot of secure image processing schemas designed for image transmission over a network, the limited resources and the dynamic environment make it invisible to be used with Wireless Sensor Networks (WSNs). In addition, the current secure data transmission schemas in WSN are concentrated on the text data and are not applicable for image transmission's applications. Furthermore, secure image transmission is a big challenging issue in WSNs especially for the application that uses image as its main data such as military applications. The reason why is because the limited resources of the sensor nodes which are usually deployed in unattended environments. This chapter introduces a secure image processing and transmission schema in WSN using Elliptic Curve Cryptography (ECC) and Homomorphic Encryption (HE).

INTRODUCTION

Similar to the traditional networks, WSNs have a set of well-defined components such as the sensor nodes, the basestation and the communication unit. Sensor Nodes are distributed in open field environment to sense, process and transmit data to a specific destination. A node consist a power unit responsible to deliver power to all its units. The basic power consumption at node is due to computation and transmission where transmission is the most expensive activity at sensor node in terms of power consumption (Gaber, T., & Hassanien, A. E. (2014). These sensor nodes are consists of several components such as a radio transceiver, a built in antenna or external antenna connection, a microcontroller, and a sensor interface. These nodes have very limited and constrained resources such as memory storage, energy, and processing power which represent the main challenge of using them. The basestation is called the sink point to which all network data are directed. It is normally a resourceful node having unconstrained computational capabilities and energy supply (Fouad et al., 2015). There can be single or multiple basestations in a network. Sensor nodes use radio frequencies or optical communication in order to achieve networking. This task is managed by radio units in sensor nodes that use electromagnetic spectrum to convey the information to their destinations. Usually each sensor node transfers the data to other node or sinks directly or via multi-hop routing as shown at Figure 1.

WSN as a new category of computer-based computing platforms and network structures is showing new applications in different areas such as environmental monitoring, industrial automation and manufacturing, health care and military applications. Depending on these applications' requirements, the need for processing, transmission, evaluation of images and large amounts of data in WSNs is increased. Controlling these data at sensor nodes before transmitting it to the basestation is an important issue to avoid the energy exhaustion during the data transmission and aggregation process. Therefore, the clustering model (Thakkar & Kotecha, 2014), which is shown at Figure 1, is proposed to manage the data transmission between nodes in order to avoid consuming resources. However, forming the network clusters is non-trivial challenge due to the dynamic nature of the working environment with the resources limitations of sensor nodes. Each cluster has a CH node that is responsible of managing all operations of gathering data from all clusters nodes, sending it to the basestation, and receiving a feedback of messages and requests from the basestation.

Selecting the Cluster Head (CHs) is a cumbersome process (Thakkar & Kotecha, 2014) that greatly affects the network performance. Although there are several studies that proposed CH selection methods, most of them are not appropriate for dynamic clustering environment. In addition, security is a, essential challenging issue in Cluster-based WSNs, since sensors are usually deployed in hostile environments. The traditional security method cannot applied for WSN due to its characteristics, such as open communication medium, limited computational capabilities of nodes, and the disadvantages of bandwidth constraint (Ganesh & Amutha, 2013), which make them more susceptible to malicious attacks than other networks. In addition, CH in the network that responsible of the data aggregation from a set of SNs consumes more energy than common nodes and will quit the mission in advance due to energy exhausting because it must decrypt and re-encrypt the data after its aggregation. WSNs thus require efficient secure routing schemes in terms of memory size, energy consumption, and operating speed.

To avoid resource consumption in WSN such as energy during image transmission, many researches are conducted and proposed image encryption and transmission schemas. However, the memory size required to store the encryption key in these methods still represent a hot topic for researchers. To address these challenges, a lot of works based on traditional encryption schemes, e.g. (Ganesh & Amutha,

Related Content

Cloud Services Publication and Discovery

Yasmine M. Afify, Ibrahim F. Moawad, Nagwa. L. Badrand Mohamed F. Tolba (2017). *Handbook of Research on Machine Learning Innovations and Trends (pp. 204-228).*

www.irma-international.org/chapter/cloud-services-publication-and-discovery/180946

Medical Image Classification Using an Optimal Feature Extraction Algorithm and a Supervised Classifier Technique

Ahmed Kharrat, Karim Gasmi, Mohamed Ben Messaoud, Nacéra Benamraneand Mohamed Abid (2011). *International Journal of Software Science and Computational Intelligence (pp. 19-33).*

www.irma-international.org/article/medical-image-classification-using-optimal/55126

Application of Machine Learning Techniques for Railway Health Monitoring

G.M. Shafiullah, Adam Thompson, Peter J. Wolfsand A.B.M. Shawkat Ali (2012). *Machine Learning: Concepts, Methodologies, Tools and Applications (pp. 2044-2067).*

www.irma-international.org/chapter/application-machine-learning-techniques-railway/56241

Gene Selection from Microarray Data for Alzheimer's Disease Using Random Forest

Kazutaka Nishiwaki, Katsutoshi Kanamoriand Hayato Ohwada (2017). *International Journal of Software Science and Computational Intelligence (pp. 14-30).*

www.irma-international.org/article/gene-selection-from-microarray-data-for-alzheimers-disease-using-random-forest/181046

The Logical Rules of Commonsense Reasoning

Xenia Naidenova (2010). *Machine Learning Methods for Commonsense Reasoning Processes: Interactive Models (pp. 88-101).*

www.irma-international.org/chapter/logical-rules-commonsense-reasoning/38481